THURSDAY, FEBRUARY 18, 1915.

## VITAL STATISTICS.

*Vital Statistics Explained: Some Practical Suggestions.* (The Chadwick Library.) By J. Burn. Pp. x+140. (London: Constable and Co., Ltd., 1914.) Price 4*s.* net.

IN a preface to this work Sir William Collins, as chairman of the Chadwick Trust, explains that the volume is based upon a course of lectures delivered at Liverpool, under the auspices of that trust. Mr. Burn pays a high compliment to the present Registrar General on the improvements introduced by him into the annual reports of his department, and says that it is now for the first time "possible to discuss and analyse the enormous mass of statistics in a coherent and intelligent manner."

The author deals first with the Census as an index to the development of national life. A comparison of the twelfth census, taken in 1911, with the first, taken in 1801, shows a wonderful advance. Mr. Burn thinks that nearly all the information that can be relied upon is now collected. He deprecates further elaboration. "Merely to ask an extra question on the census paper does not ensure a correct answer being given."

The leading facts that are shown by the Census returns and the reports of the Registrar General are: (1) a steady decline in the marriage rate during the last thirty years; (2) a steady increase in the mean age at marriage for both sexes; (3) a reduction in the birth-rate, both as regards legitimate and illegitimate births; (4) a reduction in the infantile death rate. While these observations are closely related, they point to a number of contributing causes.

The success which has attended the measures that have been taken of late years for sanitary improvement is shown by the statistics of death from various diseases. Small-pox is practically non-existent. Phthisis and tuberculosis have decreased by more than 50 per cent. during the sixty years since 1851. On the other hand, the deaths from cancer have greatly increased. All these statements have to be qualified by the possibility of differences of definition in successive records.

After a brief chapter on the preparation of mortality tables, in which he suggests that in addition to the national tables, municipal and occupational tables should be prepared, Mr. Burn proceeds to show how such tables may be put to practical use by medical men and other persons, and the light they might throw upon causes of death and upon the prevention of disease. For this purpose he has examined the rates of mortality of the industrial branch of the Prudential Assurance Society, of which he is actuary, and as these are derived from twenty million policies, he claims that they fairly represent the population of the United Kingdom, a claim which may at any rate be supported if limited to the industrial classes. He arrives at the satisfactory result that there is a steady and continuous improvement going on in the vitality of the country.

The proper method of graduating a mortality table so that the crude results of the enumeration may be smoothed into a symmetrical curve without destroying the trend of the facts, has exercised the minds of actuaries for some time. The late Mr. Woolhouse, Dr. Sprague, Mr. George King, and others have learnedly discussed it, and the method now generally adopted is that which the German actuaries call by the fanciful name of "osculatory interpolation." In an appendix to his volume, Mr. Burn gives a description of this method, so lucid and so simple that any person might employ it without having a knowledge of the mathematical principles upon which it is based. He has certainly the gift of clear exposition, and his little book is calculated to be useful to many persons to whom actuarial science has not hitherto offered any attraction.

## TECHNICAL METHODS OF CHEMICAL ANALYSIS.

(1) *Technical Methods of Chemical Analysis.* Edited by Dr. G. Lunge and Collaborators; English translation edited by Dr. C. A. Keane and Collaborators. Vol. iii, part i, pp. xxxi+538. Vol. iii, part ii, pp. xv+539—1125. (London: Gurney and Jackson, 1914.) Two volumes. Price 3*l.* 3*s.* net.

(2) *Technical Gas-Analysis.* By Dr. Lunge. Pp. xv+407. (London: Gurney and Jackson, 1914.) Price 15*s.* net.

(1) THE two sections now issued of volume iii. of this important work complete the English edition of Dr. Lunge's great monograph published in German in 1910–11. The English edition, however, differs in certain material respects from that on which it is based, inasmuch as certain German processes are inapplicable, from the very nature of the case, to British procedure, and it is unlikely, owing to special conditions, that they will ever become applicable. Hence particular sections of the work have had to be entirely re-written by British experts from the British point of view, and to this extent these may lay claim to be original productions. At the

same time the remaining sections of the work have been revised by British authorities, and, wherever necessary, modified in the same sense. In addition, each section has been brought up to date by the inclusion of all relevant matter of importance.

The sections on mineral-oils, lubricants, oils, fats, and waxes, and the special methods of analysis employed in the oil and fat industries were contributed or revised by the late Dr. Lewkowitsch—an acknowledged authority on this class of subjects. Dr. Lewkowitsch also revised the English translation of Dr. Dieterich's article on resins, balsams, and gum-resins. The same author's article on drugs and galenical preparations has been revised by Dr. Power, who has also taken charge of Dr. Gildemeister's contribution on essential oils. The sections on tartaric and citric acids have been entrusted to Mr. Davis, whilst the general subject of organic preparations—a somewhat vague class—has been dealt with by the Editor. This section is concerned more particularly, although by no means exclusively, with pharmaceutical preparations, and is based upon an article by Dr. Messner of the firm of Merck and Co., of Darmstadt. The important section on rubber has been revised by Dr. Caspari, who, however, has nothing to say concerning synthetic rubber, from which we may infer how small has been the influence of the "boom" on "artificial rubber" on the actual production of this substance.

Vegetable tanning materials and leather have been revised by Prof. Procter, an acknowledged authority on the scientific aspects of tanning; whilst sugar, starch, and dextrin have been dealt with by Mr. Arthur R. Ling—no less an authority on these particular subjects—who has also rewritten, in conjunction with Mr. Cecil Jones, a valuable article on brewing materials and beer. Paper has received the attention of Messrs. Cross, Bevan and Bacon; textile fibres that of Prof. Hübner, of the Manchester School of Technology; while Messrs. Rawlins and Rule have revised Prof. Eibner's article on inorganic colours. It will be seen, therefore, from this list of names that Dr. Keane has spared no pains in securing the collaboration of competent authorities on chemical analysis as applied to technical products and processes.

The book, like its predecessors, should find a place in the library of every consulting and analytical chemist, as well as in that of every well-equipped works laboratory. A very commendable feature of the work is the admirable bibliography which accompanies each article.

Another feature, even more valuable, is seen in the extent to which individual revisers have brought their special experience to bear upon the sections entrusted to them, thereby greatly enhancing their merit. This makes the English edition of the work doubly valuable, as compared with the German original, since each article has passed, so to say, twice through the refining fire of expert assayers.

(2) Prof. Lunge's book on technical gas analysis is in a sense the third edition of his well-known handbook of technical gas analysis, originally based upon the late Prof. Clemens Winkler's "Anleitung zur chemischen Untersuchung der Industrie-Gase." During the dozen years which have elapsed since the publication of the second edition of the handbook the subject has received an extraordinary development, and great changes have occurred in procedure and apparatus. The application of technical gas analysis has been largely extended, and its value as an analytical agent in industrial processes, and even in connection with hygiene, has been widely recognised. Hence the time had arrived when the comparatively narrow limitations of Clemens Winkler's treatise had to be discarded, and the book under review is, therefore, practically a new work, differing wholly in groundwork and arrangement from that on which it was originally based. So far as we have been able to discover, all branches of the subject have received adequate treatment. The bibliographical references are copious and up-to-date. Lastly, the book is well printed, excellently illustrated, and the indexes of authors' names and of subjects are remarkably full. T.

## TWO BOOKS ON THE EARTH.

(1) *Geology of To-day*. A Popular Introduction in Simple Language. By Prof. J. W. Gregory. Pp. 328. (London: Seeley, Service and Co., Ltd., 1915.) Price 5*s*. net.

(2) *College Physiography*. By Prof. R. S. Tarr. Published under the editorial direction of Prof. L. Martin. Pp. xxii+837. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 15*s*. net.

THESE two books are professedly written for two different types of reader; but the college student may well read Prof. Gregory's "popular introduction" from end to end, while the lover of "simple language" will find nothing to alarm him in the work of the late Prof. Tarr. (1) Prof. Gregory has brought the latest results and the current discussions of geologists before every thoughtful person to whom the earth appeals. We possess a number of popular text-books on geology, but "Geology of To-day" justi-

fies its title, and stands entirely apart. The alarming illustration with which it opens, representing a statue of Louis Agassiz plunged head-downwards in the ground, is not symbolical of the tendencies of the text. The author traces the growth of geological philosophy without exulting over the imperfections of those who have gone before. The hardy old *pièces justificatives* are quoted, but are supplemented by observations of very recent origin. On p. 141, for instance, Day and Shepherd's work on the volcanic gases of Hawaii is cited in refutation of the critical thesis so enticingly maintained by Brun; but how many of our current text-books have got so far as mentioning Brun? He certainly never shook Tarr's faith in the potency of steam as a volcanic agent ("College Physiography," p. 444), and Prof. Gregory's references are all the more welcome as recording a really memorable, if short-lived, controversy.

The chapters on "How mountains are made," with its review of the possible influence of radium, and on "How mountains are upheld," with its lucid exposition of isostasy, are good examples of Prof. Gregory's method. The section devoted to life-history, occupying nearly half the book, contains no detailed description of stratified formations, but consists of essays on "The Origin of Life," "The Interpretation of Fossils," "The Evolution of Mammals," and so forth. Miss Alice Woodward has contributed some spirited original drawings of incidents in the life of fossil vertebrates, and Hagenbeck's models at Hamburg are also utilised. In these chapters the terrestrial and fluviatile origin of the Old Red Sandstone conglomerates is well stated (p. 204); we are introduced to Gigantosaurus of East Africa, the superdreadnought of land-animals (p. 259); and to the beaked flints from the English Pliocene (p. 306), for which the author is quite willing to accept a human origin.

On glacial matters he preserves considerable caution; here only his geology seems not quite of to-day, though it is that of a very recent yesterday. To describe (p. 212) the evidence of Permian glaciation as indicating that "the climate of parts of the Southern Hemisphere was therefore colder than it is at present," must be regarded as a very moderate statement. In his memorable journeys in Spitsbergen, Prof. Gregory (p. 227) was unfortunate in not coming across modern boulder-clays. The precise parallel between the material left behind by the von Post glacier and that of deposits in the British Isles would, for instance, have reassured him. Too little seems made of the fact that sheets of boulder-clay represent the unmeltable residue of glaciers that, in their lower portions, consist half of ice and half of stones. During the melting of such glaciers there is no copious flow in the lower layers sufficient to sweep away all the finer particles. The loamy matter settles downwards in the interstices of the abundant and striated stones.

The fine series of photographs of Javan volcanoes is very welcome. So is the whole of this stimulating volume. The author does not accept (p. 81) the opinion of German writers as to the origin of their own word *feldspath*; but A. Brongniart attempted the same thing in 1807 in his "Traité de Minéralogie" (p. 355) without success.

(2) The handsome book by the late Prof. Tarr and Mr. L. Martin is of the serious and detailed type suggested by its title. It owes much to the extensive and observant travels of Prof. Tarr, and particularly to his work on glaciers and recent uplifts in Alaska (pp. 214, 390, etc.). The illustrations are numerous, and some of the diagrams would bear enlargement, those on river-erosion, for instance, being not too clear (p. 557, etc.). The view of Innsbruck on p. 525 represents the snow of spring or autumn, but not "The Alps rising above the snow line." The illustrations, however, generally supplement in a valuable way those of European text-books. The treatment of the features due to stationary and shrinking ice-sheets is especially interesting (ch. ix). The last seven chapters, dealing with the atmosphere and terrestrial magnetism, are due to the faithful and experienced editor, Mr. L. Martin, who has worked and travelled with Prof. Tarr.

GRENVILLE A. J. COLE.

## *MATHEMATICAL TEXT-BOOKS.*

(1) *Pendlebury's New Concrete Arithmetic.* By C. Pendlebury and H. Leather. First Year. Pp. 57. Price 4*d*. Second Year. Pp. 54. Price 4*d*. Third Year. Pp. 57. Price 4*d*. Fourth Year. Pp. 56. Price 6*d*. Fifth Year. Pp. 71. Price 6*d*. (London: G. Bell and Sons, Ltd., 1914.)

(2) *A First Course in Mathematics for Technical Students.* By P. J. Haler and A. H. Stuart. Pp. vi+125. (London: University Tutorial Press, Ltd., 1914.) Price 1*s*. 6*d*.

(3) *A Course of Geometry Theoretical and Practical: a Class-book for Secondary and Technical Schools.* By A. H. Bell. Pp. viii+127. (London: Rivingtons, 1914.) Price 2*s*. 6*d*.

(4) *A Treatise on Dynamics.* By Dr. W. H. Besant. Revised and enlarged by A. S. Ramsey. Fifth edition. Pp. xv+443. (London: G. Bell and Sons, Ltd., 1914.) Price 12*s*.

(5) *Examples and Test Papers in Algebra.* By W. J. Walker. Parts ii. and iii. Pp. viii+

163+338. (London: Mills and Boon, Ltd., 1914.) Price 1*s.* 3*d.*

(6) *Elementary Mathematical Analysis: a Text-book for First Year College Students.* By Prof. C. S. Slichter. Pp. xiv+490. (New York and London: McGraw-Hill Book Co., Inc., 1914.) Price 10*s.* 6*d.* net.

(7) *Stability and Equilibrium of Floating Bodies.* By B. C. Laws. Pp. ix+251. (London: Constable and Co., Ltd., 1914.) Price 10*s.* 6*d.* net.

(1) THIS set of books on arithmetic consists chiefly of examples, carefully graded in difficulty. No answers are given; teachers who use these books will look for an edition in which they are supplied. The course includes mensuration, percentage, and interest.

(2) The authors of this small text-book have succeeded in creating a "workshop atmosphere" around this elementary course; not only are the problems of a practical nature, but the student is frequently referred to drawings of simple forms of mechanism, which illustrate and furnish the data of the example set him. The range of the book includes practical arithmetic, mensuration, graphical work, and simple algebraic processes.

(3) This book is framed on the lines recommended by the circulars of the Board of Education, particularly in the first forty pages. It is claimed that the requirements of the ordinary leaving-school examinations are met, but the book is so small that most teachers will find it necessary to supplement it. There are comparatively few examples, those given being mainly numerical. Regarded as an introductory course, this small volume is of distinct merit.

(4) Dr. Besant's treatise on dynamics is well known to many generations of Cambridge men, and its re-issue in an enlarged form will doubtless be welcomed. Mr. Ramsey, who undertook a few years ago, at the author's request, the editing of part i. and the writing of part ii. of his treatise on hydromechanics, has also found time to edit and supplement this remaining volume. The increase in size is considerable, partly owing to additions to the text, but more to the very large number of problems which are now incorporated. Numerous illustrative examples are fully worked out, and notes are frequently appended to them, which the student will find instructive. We have no doubt that men reading for the second part of the Mathematical Tripos will find this volume most helpful.

(5) This collection of examples and papers is conservative in type. There is little note of originality either in arrangement or material. With regard to bookwork, only the chief theorems are inserted, and there is little explanatory matter. Part ii. includes progressions, variation, and gradients; part iii. contains the logarithmic and exponential series.

(6) This book, designed for first-year college students in America, corresponding roughly to the last stage in the secondary schools of this country, is intended to show the application of simple mathematical principles and operations to practical life. No great manipulative power is demanded of the reader; the author's object is to inspire him with new ideas and broaden his outlook. The central theme of the book is functionality. This is applied to power functions, exponential functions, and periodic functions; the fundamental transformations are treated from a kinematic point of view, by translation, rotation, and shear. The text is interesting throughout, and the author has collected an admirable set of practical exercises.

(7) This treatise for engineering students deals with the stability of bodies floating either in air or water. There are two introductory chapters which summarise the principles of rigid dynamics and hydrostatics, specially needed for the course. The author then passes to the stability of ordinary ship-forms, and this occupies nearly half the book, dealing with, among many other things, stability curves, trim curves, stability at high speeds, effect of wind and waves. In the next chapter he turns to submarines, the action of rudders, transverse stability, etc., and this is followed by the consideration of floating docks, aircraft, and caissons. The chapter on aircraft will probably be of interest to a wider circle than any other part of the book, and may be read independently. The clearness of the diagrams deserves a special word of praise.

## OUR BOOKSHELF.

*A First Book of Commercial Geography.* By T. Alford Smith. Pp. viii+151. (London: Macmillan and Co., Ltd., 1915.) Price 1*s.* 6*d.*

MR. ALFORD SMITH'S book has many useful characteristics. It is clearly written, has good maps and diagrams, and a number of appropriate pictures, and includes well-chosen and suggestive examination questions. The scope of commercial geography, however, as specified here, may not appeal to all. The statement, for example, that in order to understand commercial geography it is necessary to know what processes an article has to undergo in order to become an article of commerce, needs cautious application; it is a fault of some larger and more advanced works in this subject that, in the direction especially of manufacture, they wander far outside geographical limits. And perhaps, on the other hand, there is lacking in the book under notice a sufficiently forcible exposition of the principles

of geographical, and especially climatic, control over the distribution of products and the activities of man in making use of them. Thus, the regional division of the world according to climate and vegetation is only briefly, and not completely, referred to. It may be that some geographers have made climatic control a sort of fetish; it should not be that, but it deserves a very important place in the study of commercial geography, and calls for precise expression—as an illustration of this necessity it may be suggested that the statement in the present work that in Australia "wheat is grown up to the 20-in. line of rainfall" misses the real point of the conditions of rainfall which determine the wheat-growing area there. It should be noticed that Mr. Alford Smith inserts tables of statistics, wisely averaged, and among them details at considerable length of several large ports of the United Kingdom.

*Atlas of Japanese Vegetation, with Explanatory Text.* Edited by Prof. M. Miyoshi. (Set xv., 102–107.) (Tokyo: Maruzen Company, Ltd.; London: W. Wesley and Son, 1914.) n.d.

THIS continuation of Prof. Miyoshi's well-known atlas includes six beautiful collotype plates from photographs of the vegetation of the luxuriant mountain forests in the province of Shinano. Nothing could convey a better idea of the wonderfully varied plant communities of Japan than this carefully selected series of photographs with the accompanying descriptions, the latter being in English and in Japanese. From its geographical position, especially its great range in latitude, Japan shows a much more varied flora than any other country of similar area, from the tropical vegetation of Formosa to the alpine floras of the high mountains and the semi-arctic flora of the extreme north. The descriptions, though brief, contain much that is of interest; for instance, we learn that when the curious "luminous moss," *Schistostega osmundacea,* was discovered in one of the habitats depicted in the atlas, the Japanese Government immediately acceded to Prof. Miyoshi's request that the locality should be made a nature reserve. It is interesting to note that in this series several species of wide range in the temperate regions and familiar members of the British flora are described as growing along with characteristic Japanese flowering plants, the latter including various species well known in Britain as cultivated plants.

*Materials of Machines.* By A. W. Smith. Second edition. Pp. v+215. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 5*s.* 6*d.* net.

THIS book furnishes a very elementary treatment of the manufacture and properties of materials used in the construction and operation of machines. In the first part the author deals with fuels, refractory materials, electric furnaces, and the metallurgy of iron, steel, copper, lead, tin, zinc, and aluminium in rather less than ninety pages of a small book, and remarks in his preface that an understanding of this is essential to the study of the second part, which in 102 pages treats of the testing of materials, the iron–carbon equilibrium, cast iron, wrought iron, steel, its heat treatment, and non-ferrous alloys. The final ten pages are devoted to the selection of materials for the various parts of a steam-engine. Seeing that the metallurgical section of the book deals exclusively with the extraction of the metals named from their ores, and ignores their mechanical treatment, the only connection between parts i. and ii. relates to the metals and alloys, *e.g.*, cast iron and cast steel which are used in the cast state. Considering that the great bulk of the various steels used in machines are "worked," this omission must be regarded as unfortunate. It is certainly an astonishing thing that the author, who is an American, should apparently not know the modern processes of extracting copper which have been developed entirely in his own country, and should have described a process which originated in Swansea, and has been superseded by them. To describe the metallurgy of copper in fewer than five pages as attempted by the author is a task that few metallurgists would undertake.

*Nerves.* By Dr. D. F. Harris. (Home University Library.) Pp. 256. (London: Williams and Norgate, n.d.) Price 1*s.* net.

PERHAPS the most difficult field of physiology to reduce to simple form and language, so that it may be understood by the non-scientific laity, is that of the nervous system. Any attempt in this direction, which is accurate, is sure of a welcome. Prof. Harris, in the small volume under review, has certainly succeeded in his attempt to explain in non-technical language the place and powers of the nervous system. He does not deal with the question of the morphology and pure physiology of the cerebrum and spinal cord, nor does he consider psychology—as physiology and psychology have been dealt with already in other volumes of the series. In reality the author deals mainly with the reflex arc and its value to the organism; he also briefly discusses the causes and the value of sleep to the organism, and considers, very shortly, the conditions of "nervousness" and "excitability," their nature, and the possibility of their prevention.

On the whole the author's statements are extremely clear and trustworthy, although some of his generalisations are apt to be too sweeping. For example, it will not be generally conceded that "the transcendent nonsense of the post-impressionist painters arose from absinthe-poisoned blood" acting on an abnormal nervous system. Nor is the evidence that muscular activity is the result of the propagation of a special form of energy generated from the Nissl granules of the cerebral cells held to be, to say the least of it, convincing. Still the book is interesting and is worthy of its place in the series.

## LETTERS TO THE EDITOR.

*[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.]*

### Fine Chemicals for Research Purposes.

IN view of the shortage of fine chemicals which are used for research purposes, we thought it advisable to issue a circular to the principal laboratories in the kingdom asking for lists of chemicals not in immediate use, so that it would be possible to put the holders of such chemicals in touch with those chemists who were in urgent need of them. The replies which have been received so far have been in most cases to the effect that the holders wish to keep their own stocks in hand, but are willing to use our bureau for the purpose of purchasing others. As this attitude is one which entirely defeats the object with which the inquiry was started, may we direct the attention of chemists to the fact that it is impossible for them all to hold and to purchase at the same time. An equitable series of exchanges is all that can be arranged at the present time; and it should be remembered that even 50 grams of some particular substance may make all the difference between the carrying on or the hanging up of a piece of research work.

H. B. BAKER.
J. F. THORPE.
M. A. WHITELEY.

The Imperial College of Science and Technology, South Kensington.

### A Penalty on Research.

I AM sure that the biologists of the country will support Sir Wm. Ramsay's protest in NATURE of February 11, on the penalties incurred by men of science for the use of alcohol in their investigations. A few years ago I received a consignment of specimens of natural history in alcohol from a foreign Government expedition for scientific study and description. After some correspondence with the Customs House authorities I was allowed *as a concession* either to pay the full duty on the alcohol, or, in the presence of an officer, to pour it down the sink in the University laboratory, and replace it by methylated spirit at my own expense. Comment is unnecessary.

SYDNEY J. HICKSON.

The University of Manchester.

### The Prices of Chemicals.

A WELL-KNOWN firm of dealers in chemicals and laboratory apparatus gave a quotation some days ago for the supply of an ounce each of dulcite and adonite. They proposed to charge 9*l.* 10*s.* for the former and 6*l.* for the latter. In the price list of chemicals issued by the same firm some months before the war the prices were respectively 45*s.* and 18*s.* Is there any good reason (except greed) for this increase of price? Presumably this firm, or some other English firm with which they deal have held a stock of these sugars since before the war. The substances are indispensable in public health bacteriological work, and is it not possible that some university laboratory can undertake their preparation and distribution at cost price? J. J.

The University, Liverpool, February 3.

WE are in receipt of your letter of February 8 with regard to the price of dulcite and adonite. We very much regret that your correspondent has not gone more fully into the matter before making charges against firms who are trying to help British industries at a critical time. We should welcome a visit from your correspondent as he may not know the difficulties which have been experienced in obtaining the raw material for the manufacture of dulcite. Dulcite originally was a by-product, and was sold at 4*s.* 6*d.* per oz. The price before the war rose in stages from 4*s.* 6*d.* to 15*s.*, then to 25*s.*, then to 35*s.*, and finally to 45*s.* per oz., which was the price ruling on August 1. We had at that time only a small stock of both dulcite and adonite consisting of about 8 oz. We purchased a further supply of both these chemicals on or about August 18, but at considerably advanced prices, the supplies being obtained from wholesale chemical merchants in this country. We thereupon raised our prices to 100*s.* per oz. in the case of dulcite and 36*s.* per oz. for adonite; this gave us the same rate of profit as we had obtained from dulcite and adonite before the war.

This supply lasted us until December, when we were able to obtain a very small quantity of these two chemicals from small laboratories who had gone to the expense of manufacturing, and the prices being considerably advanced, necessitated the selling prices being raised accordingly.

At the present moment we have no dulcite of any description in stock, and have not had for some weeks. The total amount which we had for sale at a higher price did not exceed two ounces.

We have made arrangements with a firm of chemical manufacturers to manufacture for us dulcite and adonite at a price which will allow us to revert to the prices ruling between August and December last, but although delivery has been promised us several times we have not yet received delivery of even ½ oz., and we shall be only too pleased to buy any quantity of dulcite and adonite at the present moment, irrespective of price; our main point is to be able to supply chemicals which are urgently needed, and not to obtain exorbitant profits, and in the case of these two chemicals we may state we have been to considerable expense in endeavouring to obtain the necessary raw material for the manufacture of dulcite and adonite. A FIRM OF DEALERS IN CHEMICALS.

February 9.

### British Supplies of Laboratory Ware.

As chairman of the British Laboratory Ware Association I have had my attention directed to a circular letter issued by the British Science Guild, dated January, 1915, to schools, colleges, universities, and technical institutes, and also to circular No. 885 issued by the Board of Education, dated January 11, 1915, and which I note is referred to in NATURE, page 580, January 21, 1915.

These circulars have been issued under a grave misapprehension, and are likely to give a very misleading idea of the present situation in reference to supplies of laboratory glassware, and I think that it is very important that any anxiety on behalf of the readers of NATURE should be immediately allayed. I therefore beg to place before you the following information:—

The British Laboratory Ware Association, which consists of about 75 per cent. of the apparatus supply firms in the United Kingdom, was formed a few days after the outbreak of the war, in order to co-operate in connection with the production in this country of

laboratory glassware, porcelain filter papers, etc., not hitherto produced in this country.

The association is not a ring or financial combine, but is merely arranged for the pooling of information and for saving as much time, and preventing as far as possible duplication of correspondence with works, in the way of inquiries and information; the standardisation of sizes for moulds where works undertake to make; and the elimination of difficulties which would occur if all the various firms were working independently.

So far, after months of correspondence, interviews, conferences, meetings, and considerable expense, the association has solved the problem in connection with glass ware, and in a few weeks' time the various firms constituting the association will be in a position to supply the most useful sizes of glass beakers and flasks in an English-made glass similar to Jena glass, which has been tested by well-known English men of science, and can be definitely and safely recommended.

The same holds good for porcelain evaporating basins, beakers, crucibles, and covers, etc., and also for an English-made filter paper equal to the German quality of Schleicher and Schull No. 595, and further qualities of these filter papers will be forthcoming very shortly. Also, as time goes on, further items will be added to the list, as negotiations are brought to a successful issue.

You will therefore see that a great deal of important and valuable work has been done, and that the problem of glassware has been to a very great extent solved so that an English-made glass equal to the well-known Jena glass will be on the market and can be supplied in a few weeks from the present time by the various firms constituting the British Laboratory Ware Association.

C. A. MERCER,
Chairman of the British Laboratory Ware Association, Ltd.

34 Camomile Street, E.C., London, February 8.

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## Problems of Radiation.

THE study of the production of homogeneous Röntgen radiation reveals some of the most interesting and suggestive facts bearing upon the problems of radiation. A few of these will be briefly indicated.

The emission of a fluorescent X-radiation by an element exposed to a primary X-radiation of shorter wave-length necessitates the absorption of a greater amount of energy from the exciting primary beam. It is possible definitely to assign a given portion of the energy absorbed from the primary beam as connected with the emission of a particular fluorescent radiation (Barkla and Sadler, *Phil. Mag.*, 1909.) The element exposed to this primary radiation emits also a corpuscular radiation, a portion of which is definitely associated with each fluorescent X-radiation. From measurements of these associated quantities, certain broad conclusions have been found to hold at least approximately in all cases hitherto dealt with; they hold within the limits of experimental error in the one case carefully investigated. These are:—

(1) The number of quanta of fluorescent X-radiation emitted is equal to the number of high-speed electrons in the corpuscular radiation (the associated corpuscular radiation).

(2) The total energy in the corpuscular and fluorescent radiations is equal to that of the primary beam absorbed.

These are not merely hypotheses which by trial may be found to be consistent with quantitative measurements of the energies of the two secondary radiations, but are the only rational conclusions which can be drawn from experiments on *some* substances. The deviations which have been observed in other cases are subjects for further investigation; the nature of these will be indicated later.

These conclusions may be described in greater detail as follows:—

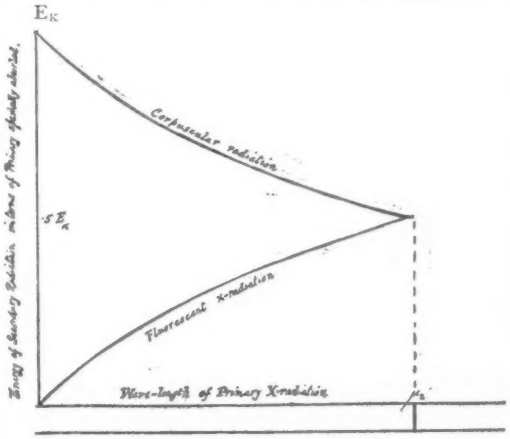
If a primary Röntgen radiation of wave-length $\mu_1$ fall upon an element with a characteristic radiation of wave-length $\mu_2$, then provided $\mu_1$ is less than $\mu_2$ the primary radiation is specially absorbed, and the element emits the particular fluorescent X-radiation, together with an associated corpuscular radiation. If we denote the energy of the primary specially absorbed in connection with the emission of the fluorescent radiation (of Series K, say) by $E_K$, the energy of the associated corpuscular and fluorescent radiations by $C_K$ and $F_K$ respectively, then $E_K = C_K + F_K$. Also as the energy of each electron in the corpuscular radiation is approximately (possibly accurately) that of a quantum of the primary radiation (we make the usual assumption here, that there is only one velocity of ejection; good reason can, however, be given for this):—

$$\frac{F_K}{C_K} = \frac{\text{energy of fluorescent radiation}}{\text{energy of corpuscular radiation}} = \frac{\text{energy of quantum of fluorescent radiation}}{\text{energy of quantum of primary radiation}} = \frac{\mu_1}{\mu_2}$$

hence:—

$$C_K = \frac{\mu_2}{\mu_1 + \mu_2} E_K \text{ and } F_K = \frac{\mu_1}{\mu_1 + \mu_2} E_K$$

So we obtain expressions for the energies of fluorescent radiation (series K) and the associated corpuscular radiation in terms of that of the specially absorbed primary energy, for primary radiation of any wave-length. Plotting energies of secondary radiations and wave-length of primary radiation, we get the curves shown in the accompanying diagram:—




Thus when $\mu_1$ is just less than $\mu_2$, the energy is equally divided between the corpuscular and fluorescent X-radiations. As $\mu_1$ diminishes a greater proportion of the energy goes into the corpuscular radiation, and less into the fluorescent, until for very short waves all the energy is taken up by the corpuscular radiation.

The above simple theory agrees exceedingly well with the experimental results obtained with the element

bromine—the one on which the most trustworthy data have been obtained. Instead of the fluorescent radiation in the particular case carrying away 50 per cent. of the energy of the primary radiation specially absorbed, experiments indicate about 47 per cent. and approximately an equal value for the corpuscular radiation. But there is evidence that with elements of higher atomic weight a limiting value of about 50 per cent. would be obtained. The indication of such a limit gives strong support to the whole theory. On the other hand, from an element of low atomic weight, the experimental value for the fluorescent radiation comes below 30 per cent., and there are indications of even lower values.

It would, however, be remarkable if such a simple theory gave perfect agreement for all elements, and correspondingly all X-radiations. The facts indicated appear of fundamental importance; deviations—real or apparent—will receive investigation and discussion later.

Other important conclusions based on the investigation are that the absorption by an atom is not necessarily in whole quanta of the primary radiation; we have evidence of absorption of primary radiation in quantities of any magnitude between one and two quanta of the primary radiation, or just possibly in fractions of one quantum.

The transformation of primary radiation into fluorescent radiation in certain cases at least is accompanied by little, if any, appreciable loss of energy within the atom.

The energies of X-radiations differing widely in penetrating power are approximately if not accurately proportional to their total ionising powers.

Details of these investigations will be published shortly. C. G. BARKLA.

Physical Laboratory, The University,
Edinburgh, February 8.

### The Green Flash.

So much has been written about the green-ray at sunset that I am somewhat diffident about adding anything. But as I find myself unable to accept the orthodox explanation of the phenomenon usually seen I write this note. This phenomenon, as seen by me on several occasions during the last summer on my way to Australia, always consisted in the last segment of the red sun before disappearance becoming a bright green (without any transition through intermediate tints); this green was as nearly as could be judged the complementary to the red of the sun itself. On one occasion I shut my eyes immediately after the green tint appeared, and it *remained visible*. There could be no doubt that what I saw was the purely subjective after-image of the disappearing segment of the sun. Of course, if this is so, it should be easy to set up a laboratory experiment to imitate the natural phenomenon; and on returning I asked Mr. E. Talbot Paris, research student in this department, to arrange an experiment in illustration. An eccentric hole was made in a disc mounted on an axle. Red glass or gelatine film was fixed over the hole, and a bright light placed behind illuminated the film and produced thereby a miniature sun, which by slow rotation, could be made to "set" behind an interposed card. At the instant of setting, the artificial sun exhibited an exact reproduction of the phenomenon of the green-ray. It was easily possible in this way to obtain a red-ray using a green sun, or a blue-ray with a yellow sun, and so on.

It is easy to give the rationale of the effect. The positive light gradually diminishes as the artificial sun passes below the horizon; and it only requires a little adjustment of the rate of disappearance in order that the negative after-image excited at a previous instant when the segment was brighter, shall overpower the simultaneous weaker positive image of the remaining segment itself.

It would not be fair for me to dogmatise and assert that this is the only phenomenon which comes under the head of the green-ray. But it is certainly the only one which I succeeded in seeing; and *it must always be present even on the possible rarer occasions when colour changes arising from dispersion are also evident.* It is certainly also what many others saw. At the same time, it must be added that the phenomenon as observed by different persons, even on the same night, was so variously described as to lead one to suppose that the subjective element is sometimes present to even a greater degree than is implied in the above note. ALFRED W. PORTER.

Physical Department, University College,
London, February 7.

### Trenching Ground and Spraying Potatoes.

IN the notice in NATURE, of February 4, of the fourteenth report of the Woburn Experimental Fruit Farm it is suggested that the negative results obtained by us in bastard trenching might have been different had we experimented on vegetables, instead of fruit trees. No doubt the suggestion is correct; and a chance observation last year gave a striking illustration in point. Brussels sprouts were grown in a piece of ground partially occupied by trees; the ground had all been dug, but there were four patches of about four square yards each where it had been practically trenched, by the removal of trees and the digging out of their roots. In each of these patches the sprouts were two to three times larger than those in the intermediate dug ground. Universal experience indicates that a good depth of rich soil is essential for successful vegetable growing; this can only be obtained by trenching and liberal manuring, and nothing in our results should be taken as discountenancing such a practice.

It is also suggested that we should accumulate results on potato spraying to see whether such treatment pays on the average. We are doing so, and those already obtained are nearly sufficient for the purpose. They extend over eight seasons, and are on a fairly large scale, though the diversity in conditions, adopted for other reasons, renders it somewhat difficult to deduce a fair average from them. As it stands, this average is 7·8 per cent. increase on the weight of sound tubers as a result of spraying. Putting the average yield at 7 tons to the acre, and the net price realised at 3*l.* 10*s.* per ton, the value of the increment will be 1*l.* 18*s.* Two sprayings would cost, for materials, labour and use of plant, about 18*s.* to 1*l.* 13*s.*, according to the substance used, and this would leave a margin of profit of from 5*s.* to 20*s.* per acre.

SPENCER PICKERING.

Harpenden, Herts.

### Early Representations of the Giraffe.

THE discussion in NATURE during the past year concerning the first mention in literature of the opossum and kangaroo has suggested a similar inquiry with regard to certain other well-known animals of the New and Old World.

When one examines into the sources whence were derived the illustrations in early printed books on

natural history, it is found that many are copied after drawings in old manuscripts.

A good example is furnished by Conrad Gesner's figure of an ichneumon, taken from an ancient MS. of Oppian, as the author declares.

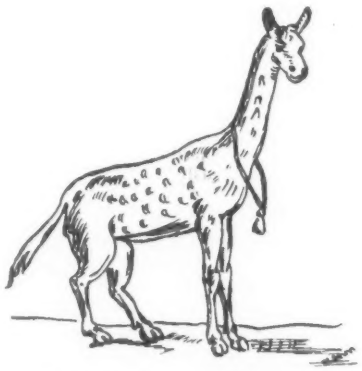


FIG. 1.—Giraffe from mural painting at Villa Pamfili, near Rome. (After Keller, from Jahn).

In the case of the giraffe, what is thought to be the earliest portrait taken from life and engraved in a printed book, occurs in a work published in 1486 by Bernard de Breydenbach, a canon of Mayence, under the title of "Opusculum sanctorum perigrinationum." The figure is, however, inferior to those

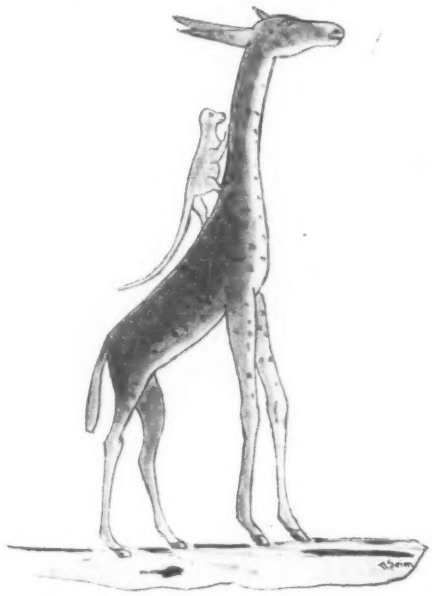


FIG. 2.—Giraffe and Cercocebus, from ancient Egyptian monument at Thebes. (After Ehrenberg).

of the same and other African mammals which are introduced in the Ebsdorf and Hereford maps of 1282.

Pictorial representations of the giraffe by Roman artists have been preserved from the time of classical antiquity, and still earlier designs have come down to us in the form of ancient Egyptian hieroglyphics and inscriptions. That some of these were remarkably faithful likenesses may be judged from the two accompanying figures, one of which is reproduced from O. Keller's "Die antike Tierwelt" (1909), and the other from a memoir by C. G. Ehrenberg, "Ueber dem Cynocephalus und den Sphinx der Aegypter," published in 1834.

C. R. EASTMAN.

American Museum of Natural History.

## The Economic Status of the Blackcap.

MR. COLLINGE does not meet the question whether the good the blackcap does in the spring balances the value of the fruit it takes in the summer. But he mentions having found a few aphids in the stomachs even in the fruit season, from which it may be inferred that more would be eaten, when there was no fruit in the spring. Now considering the enormous reproductive powers of the female aphis and that every female destroyed in the spring represents a diminution of many hundreds of the most mischievous pests that the farmer has to contend with in the summer, it seems only reasonable to conclude that the bird does *at least* as much good as harm. But the latter is seen while the former is not.

ALFRED O. WALKER.

Ulcombe, Kent, February 5.

MY experience of the blackcap is that the good it does in the spring by no means balances the harm it does during the rest of the year in fruit-growing districts.

The aphids found in the stomachs were all pea lice (*Macrosiphum pisi*, Kalt.), and were probably obtained accidentally when feeding upon peas.

I have elsewhere pointed out (*Journ. Board Agric.*, Sept., 1912) that all birds, other than doves and pigeons, feed their young upon an animal diet, of which insects form a large proportion, whatever may be the character of the food of the adult; the blackcap would, however, seem to form an exception, judging from the four nestlings I examined, whose stomach contents consisted of seeds or remains of fruit and fruit pulp.

WALTER E. COLLINGE.

8 Newhall Street, Birmingham.

## The Rusting of Iron.

I DO not know if any account of experiments such as the following on the rusting of iron has appeared in print before, but if not they may be of interest to others of your readers besides myself. Briefly, they are as follows:—

(*a*) A small flask (100 c.c. flask with long narrow neck does well) is filled to the bottom of the neck with potassium ferricyanide solution, and then the neck is filled to the top with ordinary water. A long bright iron nail is then suspended in the water without disturbing the ferricyanide solution, and in a few minutes a blue colour will make its appearance in the neighbourhood of the boundary between the water and the ferricyanide. The formation of Turnbull's blue goes on regularly, and it settles to the bottom instead of iron rust.

(*b*) A bright iron nail is placed at the bottom of a solution of potassium ferricyanide in a similar flask, and in a short time spots of blue make their appearance on the nail instead of the usual deposit of iron rust.

The explanation according to the ionic theory seems obvious.

E. J. SUMNER.

The Grammar School, Burnley, Lancs, February 5.

## STAR CLUSTERS.

OF all the telescopic objects in the sky none are more beautiful or more fascinating than the condensed, globular star clusters. Their bewildering complexity renders them unsuitable for direct study at the telescope, but photography has now brought them within the range of systematic investigation. The technical problem which they present is by no means easy, and demands high resolving power for success. The fine examples reproduced herewith, M3 and M13, have been very kindly sent from the Mount Wilson Solar Observatory, and illustrate admirably the work of the famous 5 ft. mirror constructed by Mr. G. W. Ritchey.

Considerable attention was given to the star clusters by Sir John Herschel, whose attempts to depict them by hand met naturally with small success. Certain curious irregularities which he believed to exist in the distribution of the stars may be attributed to a purely subjective origin, or they may be accounted for by the absorptive influence of external dark nebulous masses. No great importance is now attached to them, and in the main the stars may be considered as distributed with radial symmetry. But one curious feature noticed by Sir John Herschel has been confirmed by later study. The stars in a cluster tend to divide into two classes of magnitude, a brighter and a fainter, separated by a distinct interval. Can this be a visible division of stars presumably at the same distance and of nearly equal age into the two classes of giant and dwarf stars inferred by Hertzsprung and H. N. Russell?

About twenty years ago Prof. S. I. Bailey, at that time at Arequipa, devoted considerable study to photographs of the chief globular clusters. His work proceeded on two lines. On one hand he made systematic counts of the stars recorded, thus laying the foundation for statistical investigations of their arrangement in space. And on the other he investigated the magnitudes of the stars, and was thus led to the remarkable discovery that several clusters contain a high proportion of variable stars, a ratio of 1 in 7 in the extreme case of M3. His detailed results for the clusters ω Centauri and M3 have been published in two beautiful memoirs. The type of variation is of a distinct character, though a few isolated examples have been found elsewhere in the sky, with a period of about twelve hours and a rapid rise to maximum. In the case of M3 the variation is singularly true to one type, the range between maximum and minimum being two photographic magnitudes. Some clusters, notably M13, are almost entirely devoid of such variables; where they do occur they are apparently confined to the stars of the brighter order of magnitude.

The question of the distribution of stars in clusters was discussed by Prof. E. C. Pickering. Using counts on the clusters ω Centauri, 47 Tucanæ and M13 (Herculis), he formed the important conclusions: (1) that the law of distribution is essentially the same for different clusters, (2) that the bright stars and the faint stars of a cluster obey the same law. He represented graphically the curve of apparent (projected) density for different distances from the centre, and attempted without success to reproduce it by assuming laws of the form $1-r^2$ and $(1-r)^n$ for the density in space. The latter form was also tested by Mr. W. E. Plummer with much the same result on an extensive series of measures of the stars in M13.

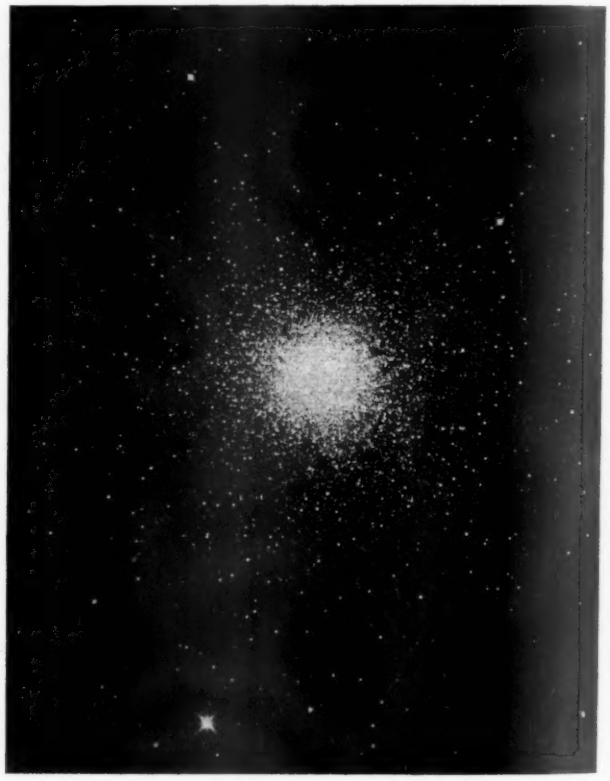


FIG. 1.—M3 Canes Venatici. Exposure 4h.

The next important contribution to the subject is due to H. v. Zeipel, who measured the positions of the stars in M3 (Can. Ven.). By adapting the solution of a certain integral equation studied by Abel he showed how the law of distribution in space may be deduced numerically from the observed distribution as it is seen in projection. Later he compared the law of density in space arrived at in this way with that which obtains in

a gravitating spherical mass of gas in isothermal equilibrium. The result represents the density of the cluster satisfactorily near the centre, but in the outer regions the cluster is less dense than the theory requires.

The physical conception thus introduced suggested other possibilities. A sphere of gas in adiabatic, instead of isothermal, equilibrium might be chosen as the standard of comparison. A series of states exists, depending on the constant ratio $\gamma$ of the specific heats of the gas, which have been extensively studied by Lord Kelvin and others. Emden's "Gaskugeln" is a work dealing exhaustively with the subject. In general, the law

FIG. 2.—M 13 Herculis. Exposure 11h. (3 nights).

of density cannot be expressed in finite terms. But there are exceptional cases in which the differential equation possesses a very simple solution. One of these, discovered by Schuster, corresponds to the value $\gamma = 1{\cdot}2$. Here the law expressing the density at the distance $r$ from the centre takes the form:

$$3a^2N/4\pi(a^2+r^2)^{5/2},$$

where N is the total mass or number of stars. This is finite, although the distribution extends to infinity. If a finite boundary be expected it is impossible to fix one by the counts, and attempts to do so have been proved illusory by the occurrence of characteristic variable stars beyond the supposed limit. However this may be, a comparison of the law with Bailey's counts of the $\omega$ Centauri cluster showed immediately an agreement within the limits within which radial symmetry is observed. I next compared the law with Pickering's curve of the projected densities, based on the clusters $\omega$ Centauri, M13 and 47 Tucanæ (bright and faint stars treated separately). The accordance was again excellent, and left little doubt that the law represented much more than a mere formula of interpolation. When, however, v. Zeipel's counts of M3 were examined, the outer region was found to conform with the law, while the inner revealed a higher density than was to be expected. As v. Zeipel had, on the other hand, succeeded in representing the central distribution by the isothermal law, it was suggested that the true standard of comparison was a central isothermal core surrounded by an adiabatic envelope, a composite state of equilibrium actually contemplated by writers on the thermodynamics of the subject. Afterwards, by the use of similar methods, Prof. Strömgren proved that M5 (Serpentis) possesses a structure which, whatever the cause, is identical with that of M3. v. Zeipel remarked that the excessive central condensation was more marked among the bright than among the faint stars.

The problem has again been discussed by v. Zeipel in an elaborate memoir, using in this instance counts of the stars in M2 (Aquarii), M3, M13 and M15 (Pegasi). He first finds solutions corresponding to these values of $\gamma$:

(M2) 1·200, (M3) 1·156, (M13) 1·183, (M15) 1·179

Thus M2 conforms with the same simple law, which I had found to hold so perfectly for $\omega$ Centauri. On the other hand, M3 is again seen to depart from it, and even with the new value of $\gamma$ the representation is far from good. The law of density here contemplated is a solution of the equation:

$$\frac{d^2(r\rho^{\gamma-1})}{dr^2}+r\rho=0,$$

and satisfies a physical condition in being regular at the centre. The general solution, however, possesses a singularity at this point, and contains an additional arbitrary constant. Thus the particular law given above is only a special case of the general solution for $\gamma = 1{\cdot}2$, which, as v. Zeipel shows, can be expressed in elliptic functions. Accordingly, he abandons the central condition, and introduces the additional constant which is to be determined, together with $\gamma$, for each case. With this modification of the theory the values of $\gamma$ became:

(M2) 1·194, (M3) 1·198, (M13) 1·203, (M15) 1·197,

so that within the limits of uncertainty in every case the distribution of the stars is consistent with a solution of the above differential equation when $\gamma$ is assigned the value 1·2.

The analogy between the distribution of stars in a condensed cluster and the density in a spherical mass of gas of a particular type in adiabatic equilibrium thus seems to be fairly established. Even if it be supposed that the cluster is the outcome of an original nebula the question still remains why the distribution of matter should persist long after its condition has completely changed, or why the arrangement should resemble what might be expected of certain vapours (*e.g.*, chloroform). The answer given by v. Zeipel on the basis of a strict mathematical analysis is that this is in conformity with a kinetic theory which applies to an aggregate containing a high proportion of Keplerian binaries. This may be a bold application of the law of large numbers, but it is certainly an interesting conception. Since there is every reason to believe that all short period variables are binary systems the observed occurrence of these in clusters lends support to the view, though they can only represent the exceptionally close systems. The investigations here described refer exclusively to the highly condensed clusters. But there exist also clusters showing states of concentration in varying degree until probably all visible trace of organic connection is lost. In Strömgren's view the whole series represents an order of evolution by which the dense clusters grow out of more scattered forms. Whether the results will throw light on the wider problems of the structure of the sidereal universe seems doubtful in view of certain conclusions drawn by Poincaré, Jeans and Eddington as to the relevance of the kinetic theory. But taken by themselves they present questions of the highest interest which are likely to repay further study. H. C. PLUMMER.

## *ON COLOUR SENSITISED PLATES.*

### I.—IN GENERAL AND ORTHOCHROMATIC PLATES.

IT used to be customary to draw three curves above a diagrammatic spectrum, heat, luminosity, and actinism curves, the last representing the power of light to produce or facilitate chemical change independently of the temperature change. This custom survives to a certain extent, though only one of the curves, namely, the heat curve, is definite. The luminosity curve depends upon the human eye, and eyes vary, sometimes even in the same individual, with regard to their sensitiveness to light and colour. Still, it is possible to draw practically useful luminosity curves in a general sense, and by taking an average human eye, in perhaps almost an absolute sense.

But the "actinism" curve is essentially different, for here we may be concerned, not with a single organ and its possible variations or degrees of perfection, but with every substance that exists on the face of the earth or that can be prepared by artificial means. And if we limit our considerations to the very few substances that are practically utilised in photography, we find that "actinism" extends from well into the infra-red down to the Röntgen rays, which are far below what is generally known as the ultra-violet. "Actinism" extends over a range of eleven or twelve octaves for practical photographic purposes, while luminosity extends over scarcely one octave, and for practical purposes even less than this, and yet some people speak of the photographic plate as colour-blind!

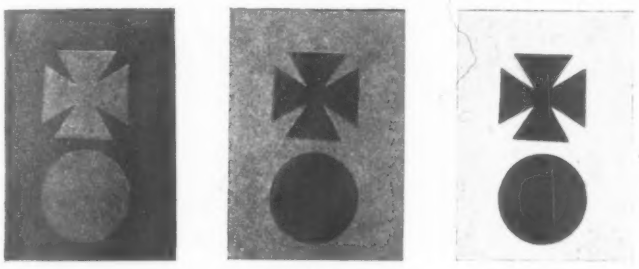
The whole of this eleven or twelve octaves has not yet been dealt with photographically, because in the extreme ultra-violet (the "Schumann region") at wave-lengths a little less than 200 $\mu\mu$, the absorbing power of air and gelatine prevents the passage of radiations through them. But this appears to be due to absorption bands, as radiations of still shorter wave-length (Röntgen rays) pass freely through these media. By getting rid as far as possible of air and gelatine, the photography of the ordinary spectrum has been extended down to wave-length 100$\mu\mu$, or even less. There are other difficulties than the air and gelatine to contend with in investigations of this region, but with these we are not immediately concerned.

Although it is necessary sometimes to bear in mind the enormous range of sensitiveness of photographic materials, even from a purely practical point of view, if we exclude the Röntgen region, and regard only those circumstances that concern the photography of objects, whether terrestrial or celestial, and whether by daylight or artificial light, we have to consider only about two octaves of radiations, or rather more if the far infra-red is taken into account. This range may be still further curtailed when daylight or glass apparatus is used, on account of the absorptive power of glass and the atmosphere, and what remains may often be sufficiently described by indicating five regions, namely, ultra-violet, blue, green, red, and infra-red. The "blue" will include the indigo and violet, and the "red" will include the orange, and the yellow is negligible as in a good spectrum it is represented by little more than the sodium D lines.

In order to photograph coloured objects so that their luminosities shall be correctly represented in the print, we want to get the curve that represents the action of the spectrum on the plate to coincide with the luminosity curve of the spectrum, and then we want a printing method that will preserve these tone values. The alternative of getting equal and opposite errors in the negative and the print so that the one shall correct the other, may have a degree of possibility about it. The fact to be emphasised is that the getting of a correct negative is not the whole business. Indeed, the getting of the two curves to correspond is not the whole business so far as the negative is concerned, for they may correspond at one exposure of the plate to the spectrum and not at another, because the steepness of the gradation of the deposits produced on the plate by equivalent ranges of exposures to the various parts of the spectrum is not the same. These difficulties are mentioned to show that, from a practical point of view, "ortho-

chromatic" or "isochromatic" photography, or whatever it may be called, cannot yet even be regarded as an absolute matter; but where the discrepancy in the use of "ordinary" plates is of the order of a thousand to one, there is plenty of room and need for improvement, before getting, as it were, within sight of perfection.

When the spectrum is photographed on an ordinary plate, the green and red, which are bright to the eye, produce little or no effect; they might as well be black, while the blue and ultra-violet, which are dark and black to the eye respectively, produce a considerable effect, as if they were bright. Similar results are obtained with ordinary objects; slate roofs, being bluish, come much too light; bricks, being red or reddish, come much too dark; grass and green foliage too dark, and so on. The plate is sensitive to all these colours, but it is very much too sensitive to blue, or not sensitive enough to green and red. By causing the light that falls upon the plate to pass through a colour filter that will reduce the brightness of the blue light to about one-thousandth part of its intensity, and increasing the exposure proportionately, the green and red will be given an opportunity to act, and the result will be much improved. To increase exposures to one thousand times the usual length may sometimes be possible (say two minutes instead of the tenth of a second), but the undesirability of such an increase need not be pointed out.



Ordinary Plate. Iso- Plate without screen. Iso- Plate with screen.

FIG. 1.

Dr. H. W. Vogel, in 1873, discovered that by the application of certain colouring matters, it was possible greatly to increase the sensitiveness of plates to green and red light. About ten years later the application of this principle began to be made a commercial matter, and Messrs. Edwards and Co. secured the patent rights in this country. These isochromatic or orthochromatic plates were a great step in advance. The three illustrations (Fig. 1) were prepared many years ago from a design for which the writer was indebted to Mr. B. J. Edwards. The cross and the disc in the original are of such dark shades of blue, that from a distance of from one to three yards, according to the sensitiveness to blue of the eyes of the person looking at the card, they appear quite black, while the ground colour is a bright yellow. On the ordinary plate the yellow comes out darker than the almost black blue. The improvements obtained by using an orthochromatic plate, and then by the use of a colour filter to reduce the blue light in proportion to the yellow, are shown in the reproduction.

There are two or three matters in connection with the use of such means as these to get variously coloured objects represented according to their luminosities that may be pointed out as well from this example as from any other, bearing in mind that they represent general principles. Such plates as these ("ortho-" or "iso-chromatic") are often, if not generally, stated to be sensitive to yellow. This is misleading. Spectrum yellow, as already stated, is negligible in these matters. All objects that are yellow are yellow because they absorb blue, and send red and green light to the eye. Yellow light is a mixture of red and green. These plates have their sensitiveness increased to green and not to red. If, therefore, we so arrange our colour filter as to get full correction for yellow, that is, that yellow and blue shall be correctly represented according to their luminosities, we throw the correction that ought to be borne by the green and red jointly entirely on to the green, and this colour is therefore over-corrected. Greens will therefore be represented too light. On the other hand, the increased sensitiveness does not extend over the whole of the green, it is chiefly in the yellowish-green, and the curve of sensitiveness shows an important depression in the region that may be roughly indicated as being between E and F. Pure yellowish-greens tend, therefore, to be over-corrected on this account also, but what is perhaps of more importance is that a green that comes in this depression of sensitiveness will be under-corrected and come out too dark. This is not a mere theoretical difficulty, for M. Callier, who is a most careful investigator, finds that the green of pine trees largely corresponds to this deficient sensitiveness, while that of grass corresponds rather to the specially sensitised yellowish-green. Therefore these two greens are represented as more different in brightness than they really are.

These facts illustrate the difficulties that result from the fact that specially sensitised plates have not an evenly graded sensitiveness. There is the maximum for the plate, and a new maximum for the new compound introduced. Such irregularity might be compensated by a complex colour filter, but of course only approximately and with much trouble and considerable increase of the necessary exposure.

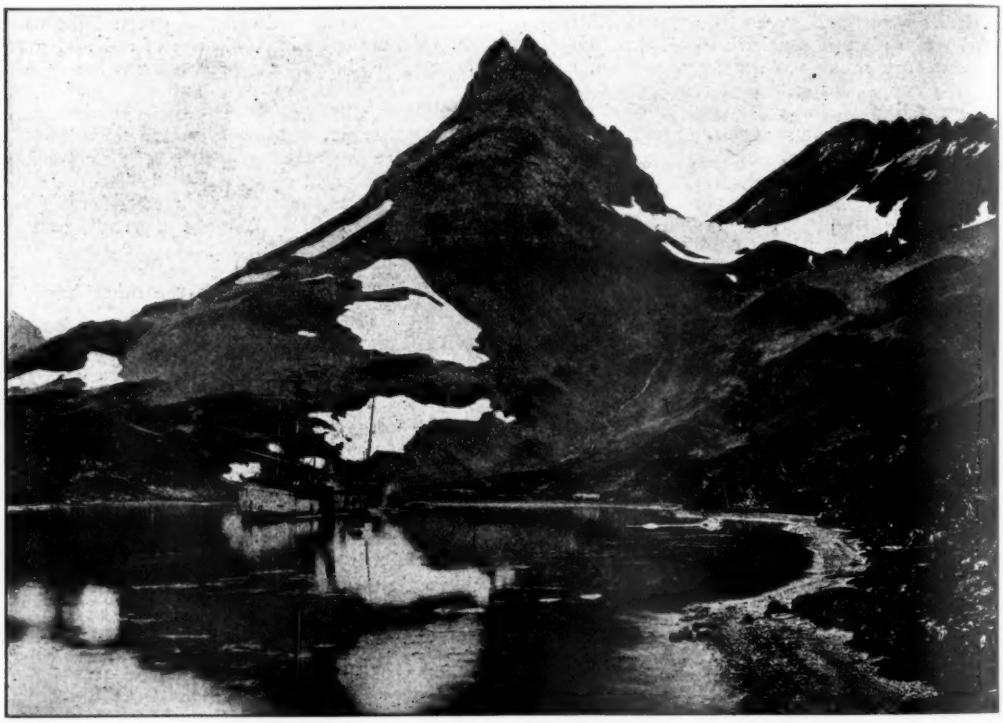
The "ortho-" or "iso-chromatic" plates of commerce are generally of the type just discussed, and are sensitised by erythrosin or a similar substance. In a second article we shall refer to "panchromatic" plates and other matters.

CHAPMAN JONES.

## WHALING IN SOUTHERN SEAS.

MR. THEODORE E. SALVESEN makes a very interesting report[1] on the whale fisheries of the Falkland Islands and dependencies. Whaling in southern seas began, he tells us, with the eighteenth century, the first British fleet of twelve vessels sailing in 1725. They went after sperm whales or cachalots (*Physeter macrocephalus*) and southern right whales (*Balaena australis*), which were harpooned from rowing boats. In the first half of the nineteenth century there were as many as 500–600 whalers so employed—wooden sailing ships, complete in themselves, the blubber being rendered into oil on board. But this kind of vessel is now practically unknown, its place having been taken by the modern steam whaler; and the venue has changed, in the far south at any rate, from sperm whale and right whale to the finners. The sperm whale is seldom met with in the waters round the Falkland Islands and dependencies, its normal habitat being in warmer zones, and the southern right whale is no longer specially sought after, since the price of baleen has fallen so low. Thus attention has been directed to the blue whale (*Balaenoptera sibbaldii*), the largest living animal in the world, to the finner whale (*B. musculus* or *physalus*), to the small fish whale (*B. borealis*), and to the humpback whale (*Megaptera boops*)—all of them often called "finners." As they are more active than the sperm whale and the right whale and only awash for a very short time when breathing, and as they sink after being killed, they were left entirely unmolested in the old days. But now their turn has come.

It was a Norwegian captain, Svend Foyn, who worked out, in the north, about 1866, the method of capturing finner whales, and his devices, with improvements, are now in use by all the modern whaling companies. The whale-catcher is worked by steam, not by men with oars; the whale gun is a finely fashioned cannon; the harpoon carries a shell, the whale line is connected with springs or accumulators; if the whale be not mortally wounded the gunner plays it as an angler his salmon; to keep the carcase afloat it is inflated with air by means of a steam air-pipe from the engine-room! Everything is specialised. And another difference as compared with old days is that the reduction of the carcase is accomplished in a factory on shore or in a large vessel (up to 7000 tons) moored in a harbour.



Floating factory S.S. *Restitution* of North Shields, Possession Bay, South Georgia. From "Report on the Scientific Results of the Scottish National Antarctic Expedition."

Besides the baleen, which no longer pays well or at all, and the oil which is graded into qualities according as it comes from the blubber, the fat of the tongue and kidneys, the flesh and bones, and the refuse, there remains the dried flesh and bones.

[1] "Scientific Results Scottish National Antarctic Expedition," iv. (1914) pp. 475–486, 10 plates and map.

The absolutely fresh flesh is used to form whale meat meal, a nutritious and wholesome food-stuff, containing 17½ per cent. proteid, largely used for feeding cattle. From the remaining flesh and about a third of the bones whale guano is made; and from bones alone, bone meal.

The modern whaling operations were started by Captain C. A. Larsen in 1904; and his satisfactory results led to the formation of a large number of companies, which now carry on, in the dependencies of the Falkland Islands, the largest whaling business in the world. The season from November 1, 1912, until the end of April, 1913, yielded, at South Georgia, about 5000 whales (52 per cent. humpbacks, about 42 per cent. finners, and about 6 per cent. blue whales). These produced about 200,000 barrels of oil and about 8000 tons of guano. At the South Shetlands and Graham Land the much shorter season yielded also about 5000 whales; at the South Orkneys the still shorter season yielded about 800 whales; at the Falkland Islands only 87 whales were brought in. The total production was about 430,000 barrels of oil—more than half the world's output for that season—and 8375 tons of guano, the gross value being about 1,350,000*l.* sterling. The industry gives employment to about 3500 men. The report is a business-like document, very lucidly presented by one who evidently knows what he is talking about. No indication is given of the probabilities of continuance. We hope that the shortness of the season will suffice to give the finners a chance for many a year to come.

## *CHEMISTRY AND INDUSTRY.*

WE live in an age of specialisation; in no era has the statement that "monomania is the secret of success" approached more closely to the truth. Business is an instinct, chemistry a science, and although it is conceivable that it is of advantage for the chemist to possess some business instinct, and for the business man to have some knowledge of chemistry, the combination in one person of acute business instinct and scientific genius is so rare as to be negligible. Both these great qualities are needed for the solution of our industrial problems—the nation lacks neither the one nor the other, but they reside in different individuals who possess entirely different types of mind. Co-ordination is the sole solution.

It has been stated that the German chemical industries have been built up by men who possess both business acumen and scientific ability. This is not the case. Men of science, such as Caro, Bernthsen, Gläser, and Graebe, and business men such as Brünck, have collaborated, and the collaboration has been successful.

Again, it is remarkable that this country should have adopted the view that there is some essential difference between the scientific chemist and the technologist; the former is dubbed "theorist," and is ignored; the latter is the "practical man," and is belauded. One of the chief reasons for German success lies in the fact that they have realised that the terms man of science and technologist are complementary, that the one must discover while the other adapts.

No chemical process, unless it is based on mere rule of thumb, can be discovered without the aid of the knowledge and experience which can only be gained by many years of scientific training. Such discoveries have to be made and worked out, in the first instance, on the laboratory scale, and this is the province of the scientific chemist. The discovery having been made, and the conditions for production, dictated by considerations of economy, having been determined, it is then the business of the technologist to adapt the process to commercial conditions. It is the lack of a true appreciation of these matters which has hampered the development of scientific industry in this country, especially in those directions in which highly trained specialised knowledge is required.

At the present time many potentially useful discoveries are made in the chemical laboratories of our universities, university colleges, and technical schools, and there are isolated instances in which enlightened manufacturers have made use of them, but in the majority of cases the scientific worker has found by sad experience that little financial profit accrues to him even though he goes to the trouble of obtaining patent protection. He is so rarely a man of business that, if he co-operates with a manufacturing firm, his elimination, from a financial point of view, is usually an easy matter. In consequence, the greater number of scientific chemists, to whom the joy of discovery is everything, and the adaptation of minor importance, prefer to publish their discoveries in the scientific periodicals, where they serve as useful suggestions to others both at home and abroad.

This unfortunate and wasteful condition of affairs can be altered if some body in authority would undertake to organise the scientific ability which is available in our educational institutions. The function of this organising body would be to receive from and to make suggestions to manufacturing firms, and to allot the problems to the scientific laboratories. The scheme would in no way affect the works laboratory, which would still fulfil its proper function of adapting the scientific details to commercial conditions. Moreover, the works laboratory could be recruited from the scientific laboratory, as is the case in Germany, by the enrolment of those men who show themselves fitted by temperament for such work.

It must not be imagined that this article is in any way a plea for the curtailment of research in pure science, which means research of a purely abstract kind, having for its object the discovery of the natural laws underlying the science, and which is, of course, absolutely indispensable. It is merely stupid to decry this form of research or to speak of its apparent lack of utility; if the laws of organic chemistry had not been determined by abstract research there would have been no coal-tar industry.

It is, then, by such a scheme as is here outlined that the scientific army of the nation can be marshalled to meet the present national emergency, but there is yet another aspect which will require immediate attention if we are to carry on the work without unnecessary hindrance.

One of the chief differences between the German and English patent laws is that while in this country a patent specification is held to be addressed to a person skilled in the art, say, to a skilled workman, in Germany it is sufficient if it is understood by an expert. This factor, apart from any intention to deceive on the part of the patentee, is responsible for the frequent "insufficiency of patent specification" which characterises both German patent specifications, as well as British specifications based upon German inventions. It is, indeed, very rare to have a German patent granted on the full text of the specification which was originally submitted to the German Patent Office. The outcome of this is that when the invention has been found novel and patentable by the examiner, the specification is promptly cut down and stripped of all such matter as he considers to be more or less obvious to an expert.

Again, the high cost of legal procedure in this country, and the fact that the Comptroller has no power to refuse the grant of a British patent for alleged insufficiency or want of subject matter, are responsible for the obtaining, particularly on the part of large German chemical companies, of a great number of "block" patents, the whole object of which is to block the development of chemical industry in this country.

It is certain that a good many chemists and chemical manufacturers are fully aware of the fact that a large number of British patents granted to Germans are merely "bluff," and could readily be invalidated were it not for the exceeding high cost connected in this country with such legal procedure; it is for this reason, also, that many small inventors stand absolutely no chance against large companies, which, in view of the high cost, are alone able to go before the Court.

Under Section 27 of the Patent Act an effort has been made to enforce the manufacture of patented inventions in this country by what is generally known as the "compulsory working" clause. It seems to be now admitted that this arrangement has not worked in practice, and its failure is due mainly to the lack of organisation, in this country, of the scientific ability which is vital to all modern industries.

In conclusion, I should add that I am indebted to Mr. J. E. Pollak, of the firm of Messrs. Dicker, Pollak, and Derrimann for the above information respecting the working of the patent laws.

JOCELYN THORPE.

## NOTES.

WE regret to see the announcement of the death on January 24, at seventy-six years of age, of the astronomer, Prof. G. F. J. Arthur Auwers, of Berlin, foreign member of the Royal Society and associate of the Royal Astronomical Society.

DR. T. WESLEY MILLS, emeritus professor of physiology, McGill University, Montreal, died suddenly in London on February 14.

THE council of the British Medical Association has decided that the annual meeting, which was to have been held at Cambridge this summer, shall not take place. The statutory annual general meeting of the association, and the annual meeting of representatives will, however, be held.

GOOD progress is being made, says the *Pioneer Mail*, with the scheme for the establishment of a School of Tropical Medicine in Calcutta, with which the name of Sir Leonard Rogers is associated. An excellent site has been secured close to the Calcutta Medical College, and the buildings are in course of erection. The first subscription list shows that a lakh and three-quarter rupees has been obtained already, and another half-lakh is practically secure.

M. LOUIS MOISSAN, son of the late Prof. Henri Moissan, and assistant at the Ecole supérieure de Pharmacie at Paris, who died on the field of battle on August 10, has left to his school, in addition to the scientific estate of his father, the capital sum of 200,000 francs for the foundation of two prizes—one for chemistry (prix Moissan), and one for pharmacy (prix Lugan), in memory respectively of his father and his mother, *née* Lugan.

THE Royal Astronomical Society has taken the first step towards placing itself in line with a number of other scientific societies by deciding at the anniversary meeting on Friday last, February 12, "That this meeting approves of the admission of women as Fellows and Associates of the Society, and requests that all steps necessary may be taken to make their election possible." The meeting was almost unanimously in favour of the proposal—fifty-nine fellows voting for it to three against—and a supplementary charter will now be applied for in order to put the resolution into force.

AT its annual meeting, held in Saint Louis on December 28 last, the Federation of American Societies for Experimental Biology—which includes the Physiological Society, the Society of Biological Chemists, the Society for Pharmacology and Experimental Therapeutics, and the Society for Experimental Pathology—passed the following resolution addressed to the men of science belonging to the nations of Europe now at war:—"That we extend to the scientific men within these nations the hope of an early and enduring peace, which will leave the nations with no permanent cause of rancour towards each other, and which will ensure to each the glories of scientific and humanitarian achievement in accordance with its own conception of these ideals."

THE council of the Royal College of Surgeons has given permission to the Royal Anthropological Institute and Prehistoric Society of East Anglia to hold a combined meeting in the museum and theatre of the college, Lincoln's Inn Fields, W.C., on the afternoon of February 23. Many recently discovered specimens will be shown and discussed, proceedings commencing at 2.30. An evening meeting will be held on the same

day in the rooms of the Royal Anthropological Institute at 50 Great Russell Street, W.C., at 8.15, when Mr. Charles Dawson will give a descriptive and illustrated account of the various cultures found in the deposits of the valley of the Sussex Ouse—particularly of the implements recently discovered at Piltdown. Mr. Dawson will also bring forward new evidence bearing on the origin of eoliths, and will exhibit Catalonian silk amulets in the form of prehistoric weapons.

UNDER the auspices of the London Manx Society a meeting was held in the Geological Society's Rooms, Burlington House, on February 13, to celebrate the centenary of the birth of the distinguished naturalist, Edward Forbes. He was born at Douglas, in the Isle of Man, on February 12, 1815, and died at Edinburgh, where he held the University chair of natural history, on November 18, 1854. The president of the Geological Society (Dr. A. Smith Woodward) presided, and addresses were given by Sir Archibald Geikie and Prof. Edward Hull, who had personal memories of Forbes. Sir Archibald Geikie suggested that an Isle of Man Museum might be regarded as a most appropriate memorial of Forbes in the island of his birth, and could be made to include illustrations both of the natural history and of the antiquities of the country. Mr. A. P. Graves added that the associations of Manx literature might also find a place in such an institution. After the meeting the members of the London Manx Society visited the Museum of Practical Geology, Jermyn Street, where Forbes worked for many years as naturalist to the Geological Survey. In the evening, a second meeting and conversazione were held in the St. Bride's Institute.

SEVERAL correspondents have sent us descriptions and sketches of a sun-pillar capped with an arc of a secondary halo, observed during the afternoon of February 11. Writing from Stonyhurst College Observatory, Mr. W. McKeon states that at 0h. 30m. p.m. the ordinary halo of 22° radius was observed, capped by a bright "arc of upper contact," which not only accompanied the halo throughout the whole afternoon, but outlived it by quite thirty minutes. "At 3.15 p.m. a hazy beam of white light began to project upwards from the sun. This gradually brightened and lengthened until by 4.30 it reached the bright arc of contact 22° N. By this time the halo proper was quite faint, while the 'solar pillar' supporting, as it were, the arc of contact, was very bright, and stood out most conspicuously. Just before 5 p.m. the 22° halo had quite vanished, at which time the 'arc' and 'pillar' changed to a strong pink, and continued thus, without the halo, as a most striking object until 5.25 p.m., when both together suddenly faded away." The origins and characteristics of these and related optical phenomena in the atmosphere were discussed in articles in NATURE of June 13, 1912, and April 3, 1913.

"ALDERMAN ARCHIBALD said he did not think the principle was right; it was really a political question." We quote from a report of a meeting of the Middlesbrough Education Committee, at which a circular letter was read from the British Science Guild, asking if a general undertaking would be given to purchase British glass for school laboratory purposes for a period of three years after the war. Seventy per cent. of the public schools represented on the Headmasters' Conference are willing to afford this support to manufacturers contemplating expenditure upon plant for the production of the glassware hitherto obtained mostly from Germany and Austria, but Alderman Archibald suspects that the effort being made to encourage the establishment of these factories is a political move in which the Middlesbrough Education Committee would be unwise to take part. We have fortunately been relieved of the disputes of party politics for the past six months, but apparently the guardians of education at Middlesbrough think that a body like the British Science Guild has been got at by political propagandists, and is trying to forestall legislation of some kind; for the Committee decided without discussion to take no action for the present. Meanwhile the supplies of glassware for laboratories are getting low, and, following Alderman Archibald, nothing must be done to stimulate enterprise in its manufacture here because the attempt to meet an educational want is "really a political question." That an education authority should commit itself to such a view is a pitiful sign of local inability to understand national needs.

THAT the protective treatment against typhoid fever is indeed protective, we all are agreed. Not one man in a hundred thousand disbelieves this plain fact; the only question is whether the treatment ought to be made compulsory. Soldiers take non-compulsion as evidence that the authorities are not sure of the great value of the treatment. "If you believed in it, really believed in it, of course you would make it compulsory." That is the argument; and a very sound argument it is. We may be sure that compulsion would meet with no serious opposition among the men themselves, and would make no appreciable difference to recruiting. Of course, clear instructions ought to be given to all men how to take care of themselves after the treatment. For two days, a man ought to keep quiet; he ought to avoid exposure to the risk of pneumonia; and he ought to leave off all alcohol. If a man, for two days after each of his two doses, will keep quiet, and keep warm, and keep teetotal, he may be absolutely certain that he will have very little trouble from the treatment. All experience, ever since the South African war, has gone to emphasise the danger of direct infection from the surface-soil. It is man who infects men. When the hot weather comes he will have the assistance of swarms of flies; there will be not less typhoid but more. Happily, vast numbers of our troops are already protected; and the "conscientious objector" is likely to feel the "pressure" of his own comrades in the ranks. If the Government adopts some measure of compulsion, it will be a very popular action. It would bring the Government gratitude and censure in the proportion of the sack to the bread in Falstaff's tavern-bill.

THE gold medal of the Royal Astronomical Society was presented, at the meeting of the society on February 12, to Prof. A. Fowler in recognition of his spectroscopic investigations of sun-spots, stars, and comets, and related laboratory researches. In a short survey of Prof. Fowler's work, the president, Major E. H. Hills, referred to his association with, and extension of, the study under laboratory conditions, initiated by Sir Norman Lockyer, of various elements represented in celestial spectra. By these means he discovered that many of the band lines peculiar to the sun-spot spectrum are due to magnesium hydride, the existence of which, together with flutings of titanium oxide and calcium hydride, indicate that spots are regions of reduced temperature. This view was further supported by the observation that the "long" lines of the higher chromosphere are generally weakened in sun-spot spectra, while the "short" lines of the lower chromosphere are generally widened or strengthened. The arc spectrum of scandium was shown to consist of two distinct sets of lines which similarly present a differential behaviour in the spectra of the sun, sun-spots, and chromosphere. In the field of stellar spectra, Prof. Fowler proved that the chief substance concerned in the production of the flutings characteristic of stars of the Antarian type is titanium oxide. The tail spectrum of comets was identified by him with the spectrum of carbon monoxide at extremely low pressures—0·01 mm. or less; and during this research a new high-pressure (100 mm.) spectrum of the same carbon compound was discovered. Investigations of spark spectra, and particularly of Sir Norman Lockyer's class of "enhanced lines," led to the discovery of a new ultra-violet series ascribed to "proto-helium," and also to a series of close doublets having the spark-line of magnesium, $\lambda$ 4481, as its leader. The bearing of these series upon theories of the constitution of the atom was discussed in the Bakerian Lecture delivered by Prof. Fowler before the Royal Society last year (NATURE, April 9, 1914, vol. xciii, p. 145).

PROF. CARL THEODOR LIEBERMANN, who died on December 28 of last year, at the age of seventy-two, left behind, in his numerous published researches, the record of a remarkably active scientific career. Carl Liebermann was born in Berlin in 1842, and spent the greater part of his life in his native town, first as assistant to Prof. v. Baeyer, and later as professor of chemistry in the Technical College of Charlottenburg, It was in Baeyer's laboratory in 1868 that young Liebermann, with his colleague, Carl Graebe, made the famous discovery of the synthesis of alizarin from anthracene, which, like modern synthetic indigo, revolutionised the colour industry of the time, and brought to a sudden end the cultivation of the natural product. It would be impossible in the course of a short notice to attempt to enumerate the variety of problems in organic chemistry to which Liebermann devoted his long life. Following up his first investigation, he made a comprehensive study of the various hydroxy-derivatives of anthraquinone and the corresponding derivatives of naphthalene (naphthazarin), from which he was led to formulate a theory of coloured compounds and mordants. He included in his researches the study of many natural and artificial dyestuffs, such as brasilin, rhamnetin, quercetin, chrysarobin, cochineal, coerulignone, and a variety of phenol colouring matters, the structure of which he was able in many cases to ascertain. In later years he turned his attention to the alkaloids, especially the numerous constituents of the coca-leaf, which he isolated and studied. Among these constituents he examined cocaine, for which he devised a method of synthesis, cinnamylcocaine, the truxillines, which he also synthesised, and also ascertained the structure of the interesting pair of truxillic acids with which they are combined; benzoylecgonine; tropa-cocaine and hygrine. The latter he also found in Peruvian cusco-leaves, together with cuscohygrine. Prof. Liebermann received the honorary degree of D.Sc. of the University of Leeds in 1906, and was also an honorary fellow of the Chemical Society.

WHEN Columbus discovered and landed on Jamaica during his second voyage, in 1494, he found it populated by Arawak Indians, who, after some hesitation, followed by bribing, received the white men in a friendly spirit. The subsequent settlement of the island by the Spaniards, and the impressment of the natives for work in the gold-mines of Haiti, as well as for agricultural labour in their own island, soon led, however, to their extermination, and by 1558 the whole Arawak nation appears to have been completely wiped out. To recover traces and relics of this lost race has been the self-imposed task of Mr. G. C. Longley, of Pelham Manor, New York, who for the last half-dozen years has passed the winter in the island exploring the old kitchen-middens. The result is a collection of some 1500 celts, fragments of pottery, grinding-stones, stone-pendants, etc., all of which have been presented by the collector to the American Museum of Natural History. They form the subject of an illustrated article by Mr. Longley in the *American Museum Journal* for December, 1914.

A NOVEL kind of nesting-box made of bark in the shape of a slug, so as to be almost invisible when affixed to the trunk or arm of a tree, is described and illustrated in the *Selborne Magazine* for February.

A WELL-MERITED protest against the treatment of horses with the home troops in the early part of their training in certain districts is formulated in the February issue of the *Animals' Friend*, where it is stated that horses taken out of good stables were tethered in the open during wet and cold weather—in some cases even without rugs. Many fine horses, as we can testify from personal knowledge, were utterly ruined, if not actually killed, by such treatment.

IN his annual fish-notes from Great Yarmouth, for 1914, Mr. A. H. Patterson, in the January number of the *Zoologist*, expresses the opinion that the fecundity of the herring is so great as to render it impossible for sea-birds, such as gannets and cormorants, even to reduce, let alone deplete, the shoals

that annually visit our coasts. The reduction in the numbers of cetaceans in recent years must also be taken into account, as well as the increasing capture of dog-fishes for food. Nothing can ever exhaust the shoals save the trawl-net, which in a few hours can destroy, in the shape of ova on the sea-bed, millions more potential herrings than those devoured in the adult state by birds in a twelvemonth.

THE most striking photographs in the January number of *Wild Life* are those of the head of a Guinea baboon and of a magnificent cluster of eggs of the large yellow underwing moth. In some instances a moth of that species will lay no fewer than two thousand of these beautifully sculptured eggs, which are at first white, but change to purple before hatching. Another good sample of photography is a badger just peering out from its "sett" beneath the trunk of a giant oak. The writer of the accompanying letterpress, or at all events the editor, should, however, have known that it is quite out of date to refer to the badger as *"Ursus" meles*. Indeed, the practice of introducing the scientific names of well-known animals in publications of this nature is altogether unnecessary.

THE Imperial Department of Agriculture for the West Indies has issued a useful pamphlet (No. 76) dealing with Indian corn (maize). The cultivation, husking, milling, etc., are described in detail, and the insect pests are fully treated with the aid of illustrations. Of these the corn-ear "worm," *Laphygma frugiperda*, is the most serious.

INDIAN Forest Bulletin, No. 26, gives an account of the resin industry in Kumaon, the preliminary experiments for which were carried out by Dehra Dun officers twenty-five years ago. The oleo-resin from the Chír pine (*Pinus longifolia*) is now successfully obtained by methods similar to those in use in the Landes district of France, and 43,000 maunds of crude resin were yielded in 1913–14.

THE buildings of the Forest Research Institute at Dehra Dun are described and illustrated in the December number of the *Indian Forester*. The buildings just completed consist of a main research institute in which the fine library is housed, a chemical laboratory with a separate distillery and separate gas-house, workshops for the economist and entomologist, an insectary, and a students' laboratory. The buildings are in red brick, uniform in style but unfortunately very far from beautiful.

THE Potamogetons of the Philippine Islands have been examined by Mr. A. W. Bennett, and his account appears in the same number of the *Philippine Journal of Science*. Only one new species is described. The almost world-wide range of some of the species of these aquatic plants is of interest, *P. angustifolius*, for instance, being found in Europe, North America, Cuba, Madagascar, India, China, and Luzon. *P. pusillus* is equally widespread. *P. javanicus* appears to be the only species found in the Philippines which extends to Australia.

IN 1901, amongst 2000 seedlings that were raised from the nuts of a certain black walnut (*Juglans Californica*) tree, growing at Santa Ana, in California, there were found twenty plants with peculiar foliage. The parent tree, which was normal, had large compound leaves, each composed of eleven to nineteen leaflets. The peculiar seedlings bore small leaves, each made up of three leaflets, or in rare cases reduced to a single leaflet. Mr. N. B. Pierce, of Santa Ana, writing in NATURE, September 10, 1914, p. 34, considered this sport to be a hybrid between the Californian walnut and the evergreen oak, *Quercus agrifolia*, which grows in the same region; and the occurrence of a supposed bigeneric cross created a sensation in California. The sport, while interesting, seems merely to be a case of arrested development, exactly similar to that of the simple-leaf ash well known in Europe, and figured in NATURE, January 7, 1915, p. 522. Prof. Babcock, of Berkeley University, has made an elaborate study of this sport, publishing the results in two profusely illustrated bulletins ("Studies in Juglans," i. and ii., Univ. of California, Pub. in Agri. Sciences, vol. ii., 1913, 1914), and comes to the conclusion that there is no evidence of hybridisation, and that the sport does not arise from visibly malformed flowers or fruits. He states that a normal tree has been found which annually produces a small percentage of the trifoliolate form. This is exactly the case with the simple-leaf ash, and the real cause of the arrested development which is present is as yet unexplained.

THE Monthly Meteorological Charts of the Atlantic and Indian Oceans for February, 1915, which have recently been issued by the Meteorological Office, give much detail of interest to the seaman, such as winds, currents, barometric pressure, temperature, and ice. The Atlantic chart mentions that the frequency of fog in February is similar to that recorded since October, and the maximum frequency in mid-Atlantic seldom exceeds 5 per cent., as against 40 per cent. in July. Steamers making the Transatlantic passage in February are not likely to be hindered by fog. Thick weather is, however, commonly experienced from December to February near the African land, due largely to dust blown seaward from the Sahara. Charts of mean salinity and surface temperature are given for the Atlantic and for the English Channel for October, 1914. The isohalines coupled with the sea surface isotherms will be of considerable scientific value with the extension of the period. The Indian Ocean chart has a copious note on submarine seismic disturbances. It mentions that some years ago the late Sir G. H. Darwin, member of the Meteorological Council, pointed out that probably the actual places of origin of earthquake shocks are usually situated under the sea in proximity to a coast. Numerous extracts are given from special meteorological logs kept on board ship, and in these the sensation is commonly described as though the vessel was grinding over a rocky bottom or reef.

IN his address to the physics section of the American Association for the Advancement of Science in

December last the chairman, Prof. A. D. Cole, of the Ohio State University, after reviewing the evidence for the existence of the electronic atom with a central nucleus, expressed the opinion that some such form of atom would soon receive general recognition. He does not, however, think that the details of any of the atomic models at present under discussion can be considered as more than tentative and provisional. The address is reproduced in *Science* for January 15, and gives a clear and readable account of the advances made during the past three years.

THE *résumé* of communications made to the French Physical Society at the meeting on January 15 includes a short account of the automatic apparatus devised by M. E. L. Dupuy for the study of the anomalies in the expansion of alloys with rise of temperature. The nature of these anomalies makes it desirable that a continuous record of the expansion should be obtained, and M. Dupuy has succeeded by means of his apparatus in obtaining records for a number of chrome-nickel steels which go far towards clearing the way for a complete explanation of their behaviour. The new apparatus requires a rod about 7 cm. long of the material to be tested, and a similar rod of silica. The two support a mirror which rotates about a horizontal axis as the lengths of the two rods become different during the expansion. A beam of light after reflection at this mirror falls on a second, which is rotated about a vertical axis as the current from a thermo-junction in contact with the specimen varies. The beam of light is received finally on a photographic plate, and a curve results the abscissæ of which are temperatures and ordinates expansions.

IN a paper entitled "Alchemy and the Devil," by Dr. J. B. Craven, Archdeacon of Orkney, read before the Alchemical Society on February 12, attention was directed to the close association which existed in the eyes both of the Church and the people between alchemy and magic, and the stern disapprobation with which such arts were viewed, as aiming at gaining the pleasures of wealth and the senses by demoniacal aid. The State joined in this denunciation, and in 1404 the practice of alchemy was made a felony in England. In 1689, however, this Act was repealed, doubtless owing to the saner and more scientific attitude towards nature and the investigation of her secrets then coming to the fore, and culminating in the foundation of the Royal Society. Whilst, in fact, alchemy and magical practices had little in common, many seekers after the Philosopher's Stone were inspired by evil motives—by greed and avarice. But others were true natural philosophers, and there was, Archdeacon Craven suggested, a still higher alchemy, which aimed, not at making material gold, but at the transmutation of the soul's dross into spiritual gold.

ATTENTION may be directed to a paper in which Mr. W. N. Haworth describes a "New Method of Alkylating Sugars" (Trans. Chem. Soc., 1915, vol. cvii., p. 8). This operation has been carried out previously by means of alkyl iodides and silver oxide, two expensive agents which have the advantage of avoiding complications, such as racemisation, the Walden inversion, and the interconversion of glucosides. It is now shown that similar results can be achieved in aqueous solutions and at about one-fifth of the cost by using alkyl sulphates and caustic soda as alkylating agents. In every case where comparison was possible, the optical rotatory power of the product was equal to that obtained by the earlier methods, and it is clear that the easier and cheaper preparation will greatly facilitate synthetic experiments in the sugar series.

THE January issue of the Chemical Society's Journal contains a redetermination of the atomic weight of tin by Mr. H. V. A. Briscoe, working in Prof. Baker's laboratory at South Kensington. It is remarkable that nearly all the previous determinations gave values approximating to 118, with the exception of five series of measurements by Bongartz and Classen, which gave the value 119·0, which has been generally used ever since. Nearly all the early measurements depended on the oxidation of tin to the dioxide or the converse reduction, but it is doubtful whether this oxide is a suitable substance for experiments on atomic weight. On the other hand, all the five methods of Bongartz and Classen depended on weighing tin in the form of an electrolytic deposit on platinum, and would be vitiated by the inclusion of mother-liquor in the deposit. The new measurements now described depend on finding the ratio, $SnCl_4 : Ag$. Fifteen analyses gave numbers ranging from 118·678 to 118·714, and eleven of these fell between 118·690 and 118·711. The atomic weight finally deduced is 118·70, and seems to be worthy of considerable confidence.

THE well-deserved popularity of the two-cycle hot-bulb, or semi-Diesel engine, is directing the attention of designers toward the perfecting of this simple type of prime-mover. Earlier examples of this type were rather uneconomical compared with the four-cycle engine, but this objection has been gradually reduced. In ease of starting, trustworthiness, etc., the hot-bulb semi-Diesel engine has undoubted advantages over some other forms. *Engineering* for February 12 has illustrated descriptions of an engine of this type made by Martin's Cultivator Company, Ltd., of Stamford. The engine illustrated gives 9 brake-horse-power at 475 revolutions per minute, and has a single cylinder 7 in. diameter by 8 in. stroke. Scavenging air is compressed in the crank-case. The engine is started by a blow-lamp, and will start in about three minutes from cold on crude oil, and in five minutes on paraffin. Regulating and governing are effected by varying the stroke of the fuel-pump. There are many points in the design of this engine which should make for trustworthiness in working and freedom from breakdown.

THE *Engineer* for February 12 contains an illustrated description of the construction of the new Mappin terraces at the Zoological Gardens in Regent's Park. The area covered by the terraces and hills takes the shape of a quadrant, and measures about

10,000 square yards. The hills are about 70 ft. high, and have an area of about 39,000 square feet; these are made in reinforced concrete about 3 in. thick. The lower terraces where the heavier animals are quartered have thicknesses varying from 5 to 7 in. No two square yards of surface are alike. The entire area was divided into squares of approximately 7 ft. side by radial and concentric lines. Contours along each of these lines were drawn, and these, together with a plaster model, enabled the scaffolding and centering to be erected. Timber being out of the question for the centering on account of the irregularity of the surface, a simple and effective substitute was found in wire netting having a fairly small mesh. By mixing the concrete fairly dry, very little escaped through the meshes. The whole is supported on reinforced concrete columns; very wide and shallow beams span the columns in both directions, and are embodied in the thickness of the slabs which form the surface of the terraces and hills. The work was completed in thirteen months.

MESSRS. JOHN BARTHOLOMEW AND CO., of the Geographical Institute, Edinburgh, have published a new and revised edition of their "Route Chart of the World," which is sold at 1*s*. on paper, and 1*s*. 6*d* on cloth.

THE Proceedings of the third International Congress of Tropical Agriculture, held at the Imperial Institute at the end of June last, have been published by Messrs. John Bale, Sons and Danielsson, Ltd., in one volume, at the price of 10*s*. net. An article describing the meetings of the congress was published in the issue of NATURE for July 9, 1914 (vol. xciii., p. 489). The volume has been edited by the honorary secretaries of the congress. It runs to 407 pages, and includes abstracts of the papers supplied by the authors, reports of the discussions, and the address of the president, Prof. W. R. Dunstan. More than 150 papers, coming from authorities in fifty different countries, were presented to the congress, and the principal problems connected with tropical agriculture were dealt with.

AMONG the forthcoming books of the *Oxford University Press* are the following:—In *Anthropology*:—Aboriginal Siberia: a Study in Social Anthropology, M. A. Czaplicka, illustrated; Contributions to the Ethnology of the Salish Tribes, J. A. Teit; Lower Umpqua Texts, L. J. Frachtenberg. In *Biology*:—Heredity and Environment, E. G. Conklin. In *Geography*:—Historical Geography of South Africa, Sir C. Lucas, part ii., from 1895 to the Present Day; Geography of Eastern Asia, D. Paton; The Voyages of the Norsemen to America, W. Hovgaard (Scandinavian Monographs, vol. i.). In *Medical Science*:—The Evolution of Modern Medicine, Sir W. Osler. In *Miscellaneous* publications:—Scientific Management, C. B. Thompson; Architectural Acoustics, W. C. Sabine.—The *Cambridge University Press* announces for early publication the following volumes in the "University of Chicago Science Series":—The Origin of the Earth, Prof. T. C. Chamberlin; The Isolation and Measurement of the Electron, Prof. R. A. Millikan; Finite Collineation Groups, Prof. H. F. Blichfeldt.—*Henry Holt and Co.* (*New York*) announce:—The Functions of the Nervous System and the Special Senses, R. P. Angier; General Zoology, Prof. E. G. Conklin; Economic Zoology and Entomology, Prof. V. L. Kellogg and R. W. Doane; Industrial and Commercial Geography for High Schools, Prof. J. R. Smith: College Text-book of Botany, Prof. D. S. Johnson.

## OUR ASTRONOMICAL COLUMN.

A NEW COMET, 1915*a* (MELLISH).—A telegram from Prof. Strömgren, Copenhagen, received at the Royal Astronomical Society on February 12, announces the discovery of a small bright comet by Mr. J. E. Mellish, of Madison, Wisconsin, U.S.A., in the position R.A. 17h., declination 3° N., and moving slowly east. A further telegram received on February 16 announces that on February 14 the position was R.A. 17h. 7m., declination 2° 54′ N. The comet is thus in Ophiuchus, and rises about 2 a.m., so that it should be visible in a small telescope between that hour and daybreak.

THE ZODIACAL LIGHT.—Those who are in a position to make observations of the zodiacal light will find some very useful information in the notes on this subject published in the U.S. *Monthly Weather Review* (September, 1914), by Mr. Maxwell Hall. The author describes the chief points which should receive the observer's careful attention, and suggests the best seasons for studying the eastern and western branches. Naturally, low latitudes are best suited for the observation; the fact that no instruments are required, but simply a level terrace and wide expanse of sky should multiply the number of those who observe this interesting and beautiful phenomenon.

ASTRONOMY AND MATHEMATICS.—In an address as vice-president and chairman of Section A (Astronomy and Mathematics) of the American Association for the Advancement of Science, Dr. Frank Schlesinger took as his subject the object of astronomical and mathematical research (*Science*, January 22). The address takes the form of pointing out to the astronomer and mathematician the great need of mutual help, and the tendency of meetings of mathematical and astronomical societies to increase the separation between these two sciences. Dr. Schlesinger directs attention to numerous astronomical problems in the solution of which the help of the mathematician is needed, and takes as an example that which concerns spectroscopic binaries, which offers a rich field.

THE MADRID OBSERVATORY'S ANNUAL FOR 1915.—The Annual for 1915 issued by the Madrid Observatory under the editorship of Prof. Iniguez, is a volume of 703 pages. The first two hundred pages are devoted to tabular statements regarding the ephemerides of the sun and moon, followed by those of planets, satellites, and comets, and facts dealing with eclipses and occultations, together with some numerous useful tables. These are followed by several articles by different authors, among which may be mentioned a long article on time determination, and a preliminary account of the solar eclipse expedition of August last. A *résumé* of the observations of the sun made at the Madrid Observatory during 1913, including spots, faculæ, prominences, etc., is given, concluding with the meteorological observations made during the same year.

WHAT IS GRAVITATION?—"It is scarcely too much to say that the nature of gravitation remains as much

a mystery to-day as when the law was first formulated by Sir Isaac Newton." Thus writes Prof. Eddington in one of those excellent articles on "Some Problems of Astronomy," which appear monthly in the *Observatory* (February, p. 93). The article continues as follows:—"In the meantime, theories of matter, of æther, and of electricity have arisen, have held their vogue, and have been superseded by others; but gravitation stands apart from these changing views. No experiment has as yet shown any relation between it and the other phenomena of nature; the simple law, unconditional and universal, has been all-sufficient hitherto. We have grown accustomed to regarding gravitation as something outside the scope of ordinary physical theories. If a new model of the atom is put forward, we ask if it accounts for the Zeeman effect, for chemical affinity, for the dispersion of light, and a host of incidental phenomena; but it would be considered unfair to suggest that it ought to account for the one fundamental and universal property of matter—gravitation." Prof. Eddington then discusses suggestions that have been made concerning possible mechanisms for gravitation, and finally asks the question, "Does gravitation conform to the principle of relativity?" A decisive result of one of the tests, whether it be positive or negative, would, he states, be of remarkable importance, and "a positive result would mean that gravitation has been pulled down from its pedestal, and ceases to stand aloof from the other interrelated forces of nature."

## *EUGENICS AND WAR.*

THE second Galton Lecture, in memory of Sir Francis Galton, born February 16, 1822, was delivered on Tuesday evening to the Eugenics Education Society by Prof. J. Arthur Thomson, of Aberdeen University, who spoke on eugenics and war. Certainties as to the effect of war on the natural inheritance of the race have not yet been established, but some probable risks are discernible. In ancient times, when fighting was the order of the day, a weaker clan may have been literally extirpated by a stronger, as black rat by brown rat; but nation does not exterminate nation nowadays. In ancient times a battle may have been an effective sifting out of the weaker, less nimble, more cowardly combatants; but it is not so now. For the elimination is either fortuitous or in the wrong direction. The finest bodies of men are chosen for the most hazardous tasks, often involving terrible mortality, and the conspicuously brave are particularly apt to be cut off. In modern warfare the sifting tends to be dysgenic.

In the second place, there is in the making and maintenance of the army, in a nation with voluntary military service, a selection of the more chivalrous, the more virile, the more courageous, the more patriotic, and among these there is a mortality high above that of non-combatants, which means some degree of impoverishment of the race. If the number of combatants was small in comparison with that of the non-combatants, the degree of impoverishment might be slight, but if we have in our British population about 6,250,000 men between eighteen and forty-five, and if we have, as we may well have, a fighting force of three millions, the disproportionate mortality among the combatants is likely to be serious. The eugenic safeguard is in the sound nucleus of "fit" and brave men who remain to keep things going, and in the women (though they again are differentially affected in Belgium and Serbia), but it looks as if this war meant for Britain a disproportionate elimination of those whom we can least afford to lose. Darwin's sentence, in reference to the past, is probably true of the present: "The bravest men, who were always willing to come to the front in war, and who freely risked their lives for others, would on an average perish in larger numbers than other men."

In the third place, there can be little doubt that the economies and retrenchments after a great war tend to handicap most severely the more highly individuated members of the community. The highly skilled, whose work is not absolutely necessary, will be pinched most; and they are the salt of the race. On the whole, the tendency of modern warfare is dysgenic.

The second subject of discussion was the Darwinian concept of the struggle for existence, in regard to which there is widespread misunderstanding. As Darwin said, the term is used "in a large and metaphorical sense," to include all forms of the clash that occurs when organisms assert themselves in any fashion against environing limitations and difficulties. The reactions may be competitive or non-competitive, self-regarding or other-regarding, with teeth and claws, or with wits and kindness. It is not doubted that one way in which animals answer back to their difficulties and limitations is to intensify internecine competition; it is maintained, however, that another way, common among the finer forms of life, is to increase parental care or to experiment in co-operation. An extraordinarily large proportion of the time and energy of living creatures is devoted to activities which are not to the advantage of the individual, and it is an inadequately appreciated part of nature's strategy that the types that survive are not only those that sharpen weapons and thicken armour, but also those in which the individual has been more or less subordinated to the welfare of the race. The improbability of war being the saving grace of human history grows upon us.

The third point in the lecture was that since war, *biologically regarded*, is, in spite of all its nobility, heroism, and skill, a reversion to the most primitive and crude form of the struggle for existence, it involves a serious risk of slipping down the rungs of the ladder of evolution. What sowings of dragons' teeth there must be in the terrible struggle of this war; is it weak to be afraid lest by and by the crop that springs from them may include something worse than armed men?

The discussion then turned to the eugenic position in regard to some practical questions. It is possible that the losses of the war, taken along with the falling birth-rate, may move public sentiment to a stronger disapproval of selfish forms of celibacy and to a stronger encouragement of chivalrous marriages. There is patriotism in dying for our country, perhaps also in marrying for her. In regard to the marriage of recruits, more than eugenic considerations have to be borne in mind, but where adequate provision is secured for the possible widows and children, there seems no reason to place obstacles in the way of the marriage of recruits of suitable age and good record. It is for eugenists to scan critically all proposals hurriedly projected to meet crises of war strain, such as putting children at the disposal of the farmer—a doubly dangerous suggestion. To be resisted also is the natural desire to economise in the higher super-necessaries, such as various forms of art, for this means crippling super-men. One of the results of the war is likely to be a freshened enthusiasm for all-round physical fitness, and it must be granted that all improvements of nurture are eugenic as long as it is clearly recognised that veneering does not make bad wood sound. The British temperament has an inherent dislike of coercion, and schemes of compul-

sory military training are to be looked on with grave suspicion. There is the risk of insidious Prussianising. For the undeniable privilege of being part of civilised Europe and for the undeniable distinction of having been willing—on this occasion—to do the right thing at all costs, we shall have to pay a long price, and it is to be feared that part of this price will be the shelving of eugenic endeavours and our connivance thereat. It may be, however, that facts will give the lie to our fears, and that the impoverishment of the possible parent-stock of the future will be in some measure counteracted by an enrichment of our social heritage—perhaps even by a nearer approach than we have ever known to *positive* peace.

## STANDARDISING APPARATUS AND METHODS.

SEVERAL circulars recently received from the Bureau of Standards of the Department of Commerce, Washington, well illustrate the untiring industry to be found in the American public offices. Circular No. 9 deals with the standardising of glass volumetric apparatus such as flasks, burettes, pipettes, pyknometers, and measuring cylinders. The bureau aims at encouraging excellence of quality in such apparatus by co-operating with the makers on one hand, and on the other with the users. To this end the circular describes specifications for the various classes of instruments, and the bureau admits for standardising that apparatus only which conforms to the specifications. It is pointed out in the circular that certain of the demands, such as those regarding the quality of the glass and the process of annealing before calibration, are largely dependent for their fulfilment on the integrity and good faith of the manufacturer. Users can therefore help to secure a high degree of excellence by supporting conscientious makers and giving consideration in the first place to quality, and only secondly to the matter of cost. The circular supplies information on such points as the best design of apparatus, the material, the methods of marking the graduations, the units of capacity employed, and the limits of error allowable. There are also directions for the manipulation of the apparatus during testing; and for those who wish to calibrate their own burettes and pipettes a brief description of the method to be employed is given.

Circulars Nos. 36, 48, and 222 deal respectively with industrial gas calorimetry, standard methods of gas testing, and flame standards in photometry. These are technical subjects, and it would be impossible in any moderate space to discuss or criticise the very numerous points raised in these circulars. It may suffice to refer to the last-named, and to state that the variation of the light of flame standards of light as determined by atmospheric conditions and as observed by different observers, or computed by different empirical formulæ, are discussed at length. It is often questioned whether the illuminating power of gas, for example, is more fairly determined by comparison with a flame standard which itself is affected by atmospheric conditions (moisture, $CO_2$, pressure), or whether a standard which is independent of these conditions, such as an electric filament lamp run under strictly defined conditions, would not be more correct. As the luminosity of the gas flame itself also is affected by atmospheric conditions, though not identically to the same extent as the flame standards of light, the practice in England is to determine the quality of the gas by reference to a flame standard, and to ignore atmospheric conditions. With an invariable standard of light gas of the same quality would appear to differ more according to the weather conditions than it does with a flame standard, and for this reason if very elaborate corrections are to be avoided the use of the variable standard is considered in this country more appropriate than that of an invariable standard.

Three technologic papers issued by the Bureau are devoted to analytical researches, and deal with the determination of ammonia in illuminating gas, the iodine number of linseed and petroleum oils, and the analysis of printing inks. The first of these, by J. D. Edwards, is of more interest in the United States, where the amount of ammonia in illuminating gas is still subject to control than in the country where no ammonia limits are now in force. It deals with the choice of indicators, effect of carbon dioxide on the titration, errors due to solubility of heads, and to incomplete washing, and the choice of absorption apparatus. Paper No. 37, by W. H. Smith and J. B. Tuttle, deals with the iodine number of linseed and petroleum oils. The main point established is that for the iodine solution used (iodine bromide in glacial acetic acid), and probably for other solutions in common use, the conditions of the experiment must be more rigorously fixed than is now usual. Thus 0·1 gram of oil with 25 c.c. of iodine solution gives a lower iodine absorption figure than when the weight of oil and volume of solution are doubled. For mineral oils the absorption increases with excess of iodine, and there is in this case no tendency to reach a constant value. Paper No. 39, on the analysis of printing inks, by the same authors, gives details of the procedure of analysis adopted at the Bureau of Standards for the separation of oil and pigment, the analysis of each separately, and concludes with remarks on the relation of aniline dyes to paper, and on the accuracy obtainable in the analysis.

## GASEOUS EXPLOSIONS.[1]

THE investigation of gaseous explosions is of interest to chemists, physicists, and engineers. The chemist studies the laws of combination and dissociation; the physicist deals with modes and rates of inflammation, variation of specific heat, maximum temperatures attained, and laws of radiation and cooling; while the engineer considers both chemical and physical effects as bearing on the practical operation and thermo-dynamics of the internal combustion engine. He also interests himself in the analogous phenomena of inflammable dust explosions as found in coal-mine and flour-mill accidents. The matters of interest are obviously numerous and complicated, and it is accordingly necessary to limit their consideration to a few points. The points selected will be dealt with as they bear more particularly on the engineering problems of the internal combustion engine. In 1907 the British Association, at its Leicester meeting, appointed a committee of investigation. This committee has been at work ever since, and much light has been thrown by the experiments of its members upon the facts connected with gaseous explosions as occurring in closed vessels and within engine cylinders having moving pistons. It is now proposed to describe some of the work of the committee, dealing first with the phenomena of rising temperature, and secondly with that of cooling after explosion.

When a mixture of coal gas and air is ignited within a strong closed vessel, it is found that the pressure rises rapidly, attains a maximum, and falls relatively slowly. To this rapid pressure rise is due the term gaseous explosion. Such explosions are

[1] Abstract of discourse delivered at the Royal Institution on Friday, January 29, by Dr. Dugald Clerk, F.R.S.

obtained with mixtures of all inflammable gases or vapours with air or oxygen, and very similar phenomena occur with like mixtures of inflammable dust. The rise and fall of pressure is studied by means of sensitive indicator devices, which produce tracings on a rotating drum.

The pressure rise is caused by the formation of flame at the ignition point—in this case an electric spark—and the spread of this flame throughout the vessel increases the temperature of the gaseous contents, and thus increases the pressure, as in a closed vessel the volume remains constant. The rate of pressure rise is thus, broadly, the measure of the rate of the travel of the flame through the mass; and, if it be assumed that maximum pressure is attained when the whole vessel is filled with flame, then it is possible to determine the flame velocity by these measurements.

In these experiments the flame velocity for the weak mixture is about 2 ft. per sec., and for the strong mixture 13 ft. per sec. These velocities are attained in closed-vessel experiments without a moving piston. In actual engine cylinders, where the charge has been introduced at a high speed through an inlet valve, the flame velocity is much higher, and it varies with different types of engine from about 20 to 100 ft. per sec. The cause of this variation for similar mixtures has been the subject of investigation by Clerk and Hopkinson, and it has been definitely proved that the higher flame velocity found in working engine cylinders is due to the residual turbulence of the mixture after compression caused by the high rate of flow into the cylinder through the inlet valve. In some engines the gases forming the charge flow through the inlet valve at a rate as high as 160 ft. per sec. Without this increase of flame velocity in the engine cylinder it would have been impossible to run high-speed engines, such as petrol engines, in an economical manner. At the lower flame velocity of the closed vessel the exhaust valve will be open before the pressure had time to rise. The effect of turbulence within the cylinder is very marked in other respects. The rate of loss of heat from a heated platinum wire to the mass of air in the combustion space of an engine is much greater for any given point of the stroke when the engine is running fast than when it is running slow, and if the charge be trapped, so as to allow several compressions and expansions before measuring the heat loss, the turbulence has so died down that the conductivity diminishes.

Another point of interest in gaseous explosions is found in the fact, predicted by Clerk many years ago, but proved by Hopkinson, that the flame entirely fills the vessel before maximum pressure is attained, that is, the combustion, even in an explosive mixture of gas and air, is relatively slow as the chemical combination approaches completion.

Another point proved by Hopkinson's experiments in a large closed vessel is that at whatever point in the vessel the ignition be started, that point is the point of maximum temperature during the subsequent pressure rise, and at that point the temperature rises about 500° above the temperature of combustion, due to adiabatic compression of the hot gas.

The investigations of Profs. Callendar, Dalby, and Coker by means of platinum resistance thermometers and platinum alloy thermal couples has proved the temperatures attained in ordinary engines to vary from about 1800° C. to 2500° C. The new methods of direct thermometric measurement of the temperature flame have amply proved, however, the general correctness of the older method of deducing mean temperature by pressure change.

The investigations of Callendar, Hopkinson, and David (Prof. Hopkinson's pupil) on radiation are of great importance, and prove that this source of heat loss is only second in magnitude to heat loss by convection and conduction. All the radiation experiments clearly show the existence of an unexpected transparency of flame to its own radiations. The radiation work throws much light upon heat distribution in the rapidly succeeding explosions used in internal-combustion engines.

It was long ago observed by Hirn, Bunsen, and others that the rise of temperature in gaseous explosions could not be calculated from the then assumed specific heat of the constituent gases and the known calorific value of the inflammable gas. The deficit of temperature was found to be about 50 per cent., and many attempts were made to explain this deficit, Hirn advocating the theory of heat loss on the rising line and Bunsen supporting the idea of a limit to temperature due to dissociation. Later, the French observers, Mallard and Le Chatelier, maintained that at least part of the deficit could be accounted for on the assumption of increase of specific heat of the gases. Investigations of the members of the Committee have dealt, not only with the points which have been here discussed, but with all these questions—heat loss on the rising line, specific heat of the constituent gases, heat loss on the falling line, and dissociation of the combining gases.

Specific heat work has been in progress by Clerk, by Callendar and his pupil, Swann, and much of this work has not yet been published. Dissociation has been discussed by Dr. J. A. Harker, Prof. Smithells, and Dr. Bone, and both internal energy and dissociation have been discussed by Hopkinson. Ignition temperatures of gases have been dealt with by Prof. Harold Dixon, and Dr. Watson has studied the nature of the exhaust gases from the petrol engine. Many experiments, too, have been made on the law of cooling and heating of gases under compression in cylinders by Hopkinson, Dalby, Callendar, and Clerk.

As a result of this work, the conclusion has been arrived at that, so far as explosions in internal-combustion engines are concerned, dissociation has but little to do with the limit reached. This limit is partly due to increased specific heat at high temperatures, to heat loss to the walls, and to radiation from the explosion. Varying specific heat and increasing radiation account for most of the deficit. Allowing for all these things, however, it appears now to be established that combustion is not quite complete even at maximum temperature, and Watson's experiments on the spectrum of an explosion flame appear to support this view.

All these matters are still under examination, and it is hoped that in the near future a much more complete knowledge may be gained than at present exists. Much is known in a qualitative way, and some quantitative knowledge has been attained, but much still remains to be done in the way of quantitative determinations of matters at first apparently so simple as specific heat.

## CLIMATE AND TREES.

IN an article on "Woods and Trees of Ireland," in the *Co. Louth Archaeological Journal* for 1914, Prof. Augustine Henry states that in Ireland, as in Scandinavia, the climate prevailing in neolithic times was drier and warmer than that of to-day. Many facts are adduced in support of this improvement, which in Scandinavia amounted to an increase of 4° F. in the average annual temperature. The occurrence of this optimum climatic period is confirmed by the

fact that two species of elm in England are unable now to produce fertile seed.

The English elm produces good seeds freely in the warm valley of the Tagus at Aranjuez in Spain, but not in Madrid on the cold plateau 500 feet higher. In England it invariably reproduces itself by root-suckers. The Cornish elm produces ripe fruit in Brittany. Certain forms of Alchemilla are unable now to produce good pollen, yet form seed parthenogenetically. In the Faroe Isles thirty-six species of plants scarcely ever ripen their seeds; and five species never flower. The question of what plants in Ireland are now in too northerly or too cold a climate requires study in the field.

Much has been written on the Lusitanian flora of Ireland, involving the question how the Arbutus is confined as a native tree to Kerry and Cork, not being indigenous elsewhere in the British Isles. Its nearest station on the continent is near Paimpol in Brittany, where, on the abrupt and rocky slope of the cliff of Trieux, for about one and a half miles, this species is very abundant in a wood mainly composed of oak and mountain ash. It is interesting to note that the Cornish elm (*Ulmus stricta*), indigenous only in our islands in Cornwall and Devon, is similarly met with in Brittany. The English elm (*Ulmus campestris*) is probably also a Lusitanian species, occurring elsewhere than in southern England only in Spain as a wild tree. It appears to have entered England by the Severn valley, crossing over the Cotswolds into the Thames valley, and southwards as far as the Isle of Wight.

Prof. Henry, in addition to giving much historical matter concerning the ancient forests of Ireland, shows how the primitive woods and their remains can be easily recognised by the occurrence in them of a peculiar fauna and flora, which is absent in plantations and in arable and pasture lands. A list is given of these sylvicole animals and plants.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

GLASGOW.—The following additional examiners have been appointed:—Surgery, Sir Charles B. Ball, Bart.; medicine, Sir Thomas Oliver; physiology, Prof. E. P. Cathcart; geology, Dr. John Horne; zoology, Mr. H. H. Brindley; engineering, Prof. J. B. Henderson; mining, Prof. W. H. McMillan.

Forty-three members of the teaching staff, professors, lecturers, and assistants, are engaged in military service at the present time, and nearly five hundred commissions in the Army and Navy have been granted to students and junior graduates of the University. One, who afterwards died of wounds, received the Victoria Cross.

LONDON.—The Senate has conferred the titles of Professor and Reader in the University upon the following:—*Professors*:—Dr. A. L. Bowley (London School of Economics), statistics; Mr. L. R. Dicksee (London School of Economics), accounting and business organisation; Mr. J. E. S. Frazer (St. Mary's Hospital Medical School), anatomy; Dr. T. M. Lowry (Guy's Hospital Medical School), chemistry; Mr. J. H. Morgan (University College and the London School of Economics), constitutional law; Dr. W. J. R. Simpson (King's College), hygiene and public health; Mr. J. H. Thomas (University College), sculpture; and Mr. G. Wallas (London School of Economics), political science. *Readers*:—Dr. R. W. Chambers (University College), English language and literature; Mr. H. Crompton (Bedford College), chemistry; Dr. J. S. Edkins (Bedford College), physiology; Mr. W. J. Goudie (University College), theory and practice of heat engines; Mr. Major Greenwood (Lister Institute), medical statistics; Dr. R. G. Hebb (Westminster Hospital Medical School), morbid anatomy; Dr. R. T. Leiper (London School of Tropical Medicine), helminthology; Dr. H. R. Le Sueur (St. Thomas's Hospital Medical School), chemistry; Dr. F. S. Locke (King's College), physiology; Miss Sara Melhuish (Bedford College), education; Dr. F. G. Pope (East London College), chemistry; Dr. H. E. Roaf (St. Mary's Hospital Medical School), physiology; Dr. O. Rosenheim (King's College), biochemistry; Mr. J. Henderson Smith (Lister Institute), bacteriology; Dr. J. F. Spencer (Bedford College), physical chemistry; Dr. H. M. Turnbull (London Hospital Medical College), morbid anatomy.

MANCHESTER.—The movement started last year for the establishment of a Radium Institution in Manchester met with a generous response from the public. Thanks to the assistance of public men and the Press, the committee that was appointed to carry out the scheme was able to collect a sum of about 30,000*l.* The radium department was established at the Royal Infirmary, and began work on January 1 in a number of rooms that had been equipped at a cost of 1000*l.*, and started with about 800 milligrams of radium metal. The contract for the radium, which cost about 21,000*l.*, was fortunately given to an American firm, and its delivery was not therefore interfered with by the outbreak of the war. In order to ensure the maximum efficiency, the Radium Committee, acting on the advice of Sir E. Rutherford, Sir Wm. Milligan, and other experts, took control of the equipment of the laboratories; and the standardisation of the radium was done in the physical laboratories of the University of Manchester. The committee has also drawn up a scheme for the distribution of radium either in the solid form as applicators, or as emanation tubes from the liquid form, to the other hospitals in Manchester and the district. Dr. Arthur Burrows is the radiologist at the infirmary responsible for the administration, Mr. H. Lupton is the physicist in charge, and Sir E. Rutherford acts as consulting physicist to the department.

OXFORD.—The Committee for Rural Economy reports that during the past academic year forty-eight individual students worked in the department. The soil survey of the district round Oxford has been continued, and a new research on the nitrogen in peat has been started. The new buildings, erected at a cost of nearly 6000*l.*, were completed and ready for occupation in October last. Several papers have issued from the school during the year, including six by Prof. Somerville (Sibthorpian professor), a joint paper by Prof. Somerville and Mr. Harper, and others by Messrs. Harper, Morison, Doyne, Sothers, and Jones. Prof. Somerville continues to edit the *Quarterly Journal of Forestry*.

The annual report of the Delegates for Forestry shows that the number of the students in the department at the beginning of the year 1914 was thirty-eight. This number by the end of the year, in consequence of the war, had declined to fourteen. A visit was paid, under the personal direction of the professor of forestry, Sir W. Schlich, to the Forêt de Lyons, in northern France, and weekly excursions were undertaken to Bagley Wood, where, by permission of St. John's College, a forest nursery and experimental plantations have been established. Here periodical measurements are taken of many species of forest trees. Advice was sought and given in respect of twelve estates aggregating 9322 acres, and other

work of an advisory nature was carried out. Valuable research has been performed by Mr. E. A. Speyer, who has now accepted a forestry appointment in Ceylon, and by Mr. W. E. Hiley. The finances of the Forestry School are assisted by an annual grant of 250*l.* from the Board of Agriculture and Fisheries.

THE authorities of the Royal Technical College, Glasgow, may well be proud of the part which members, students, and past-students of the college are taking in the King's service in connection with the war. A list, confessedly incomplete, which has been issued, gives the names of 1023 officers, non-commissioned officers, and men, together with their rank, regiment, or ship, and the last year in college, all of whom have been thus connected with the college, and the names of forty-seven other men serving about whom particulars are as yet unknown.

A COPY of the calendar for the session 1914–15 of the University College of North Wales has been received. The new calendar follows on the same lines as those of previous issues. We notice that during 1913–14 the extension work in agriculture carried out by the college was placed, as regards organisation, on a new footing. In three of the North Wales counties served by the college, advantage was taken of the offer of Government help through the Farm Institute Fund to increase very greatly the sum annually devoted to agricultural instruction and to place the work in the hands of county organisers, appointed by the college, but working under the directions of the county agricultural committees. Special lecturers in horticulture, poultry-keeping, and dairy work are also provided by the college for county work.

## *SOCIETIES AND ACADEMIES.*

### LONDON.

**Royal Society**, February 11.—Sir William Crookes, president, in the chair.—Dr. D. H. **Scott**: *Lepidostrobus kentuckiensis*, nomen nov., formerly *Lepidostrobus Fischeri*, Scott and Jeffrey.—A correction. The name *Lepidostrobus Fischeri* having been anticipated by Renault in 1890, it is necessary to give a new name to the Kentucky cone described by Scott and Jeffrey (*Phil. Trans.*, Ser. B., vol. ccv., 1914, p. 354). The fossil is now named *Lepidostrobus kentuckiensis*.—T. **Lewis** and M. A. **Rothschild**: The excitatory process in the dog's heart. Part ii.—The ventricles. (1) The excitation wave appears at the pericardial surface of the dog's heart at times which show no great variation relative to each other; but the distribution of the time values over the surface with such variations as they show is very fairly constant from heart to heart. (2) The time at which the excitation wave appears at the surface is controlled by the length of the Purkinje tract to the endocardium beneath the region tested, and by the thickness of the ventricular muscle in the same region. (3) The excitation wave is not propagated by simple spread from base to apex or apex to base through bands of muscle fibres, as has commonly been held hitherto. (4) The capacity of striated cardiac tissue to conduct appears to be related to the size of the cells composing it and to its load of contained glycogen. (5) The auriculoventricular bundle and its branches constitute a system of fibres specially endowed in regard to their arrangement and physiological properties to give quick distribution of the excitation wave throughout all parts of the ventricle.—A. J. **Walton**: The variation in the growth of mammalian tissue *in vitro* according to the age of the animal. Previous work has shown that plasma of animals varies considerably in its value as a medium for the cultivation of tissue. The present experiments were carried out with a view of determining whether these differences were due to the age of the animal from which the plasma was obtained. The tissues and plasma of rabbits were alone used, and the majority of animals were of a known age. Tissues of young and old animals were used and were grown in pure plasma from the same animals. In all cases it was found that the young tissues grew better than the old, but the plasma of the young animal was not nearly so satisfactory a medium as that of the old animals. Hence the best results were obtained when young tissues were grown in the plasma of old animals and the worst results when old tissues were grown in young plasma.

**Geological Society**, February 3.—Dr. A. Smith Woodward, president, in the chair.—Prof. T. McKenny **Hughes**: The gravels of East Anglia. The author discusses the sources from which the subangular gravels that cover such large areas in East Anglia can have been derived. He points out that their great variety of fracture, colour, etc., proves that they cannot have come directly from the Chalk, or from Boulder Clay derived directly from the Chalk, or from the Lower London Tertiaries, none of which contain subangular gravels but only beds of pebbles, and those mostly of small size. The character of the flints in the gravels indicates that they have been derived from surface-soils which have been winnowed and shifted by soil-creep, rain, and streams, until arrested on the terraces and flats of the valleys. The dry land of Miocene age was the first over which the flints of our gravel-beds could have received that subaerial treatment which they all seem to have undergone.—E. **Anderson** and E. G. **Radley**: The pitchstones of Mull and their genesis. The pitchstones here discussed occur with extraordinary frequency, intruded into the Tertiary plateau-lavas of the eastern portion of the Ross of Mull, as well as in less number in other parts of the island. They fall into two main divisions, distinguished by the absence or by the presence of porphyritic felspars. The petrological characters of these pitchstones, and their more crystalline margins, are such that they seem to warrant the grouping of the rocks under a new type-name, and the name leidleite has been chosen. The porphyritic pitchstones occur as flat or gently-inclined sheets; they also are associated with a more crystalline phase, and have been grouped under the type-name inninmorite.

**Zoological Society**, February 9.—Mr. R. H. Burne, vice-president, in the chair.—E. G. **Boulenger**: An Aglyphodont Colubrid snake (*Xenodon merremii*), with a vertically movable maxillary bone. The vertical mobility of the maxillary bone in snakes had previously been regarded as essentially characteristic of the Viperidæ. Observations on the snake in question, which was recently received by the society from Mr. W. A. Smithers, showed that the mobility of its maxillary bones was so great that the fangs could be not merely erected, but were capable of being thrust forward and sideways, the mechanism being as perfect as in any of the vipers. Mr. Boulenger pointed out that the discovery of a solid-toothed Colubrid with vertically movable maxillæ went a long way towards settling the so often discussed problem of the derivation of the viperine maxillary bone. The author traced the probable evolution of the bone, expressing the opinion that the Viperidæ were descended from the Opisthoglyph Colubrids, and that the old view, recently revived, that they were of Proteroglyph

ancestry, must be abandoned once and for all.—Dr. W. **Nicoll**: A new species of liver-fluke from the kestrel.

**Mathematical Society,** February 11.—Prof. A. E. H. Love, vice-president, in the chair.—G. H. **Hardy** and J. E. **Littlewood**: (i) The zeros of the Riemann zeta-function. (ii) An assertion of Tchebychef.—G. B. **Jeffery**: The steady motion of a solid of revolution in a viscous fluid.—S. T. **Shovelton**: Relations amongst Bernoulli's and Euler's numbers.—W. P. **Milne**: Apolar generation of the quartic curve.

CALCUTTA.

**Asiatic Society of Bengal,** January 6.—Maude L. **Cleghorn**: A note on the floral mechanism of *Typhonium trilobatum*. Describes the trap-mechanism of the spathe, by means of which beetles are ingeniously captured at night to ensure cross-pollination. The trap-mechanism of this plant resembles that of the Cuckoo-pint (*Arum maculatum*) in the entrance and exit of the trap being above and at the same opening, but differs from it in the deliberate opening and closing of the passage leading down into the trap. Its floral mechanism does not seem to be so perfect as that of the common Kachu (*Colocasia antiquorum*), but it appears to be an advance on that of the Cuckoo-pint.—F. H. **Gravely**: The evolution and distribution of Indian Spiders belonging to the sub-family Ariculariнæ. The Ischnocoleæ found in the Indian Peninsula and Ceylon form a very compact group, probably related to those of other parts of the world through their most primitive species only. It is concluded that the Poecilotherieæ have originated from the Ischnocoleæ as a result of their adaptation to a new environment in the Indian Peninsula or Ceylon, to which they are still confined.

DUBLIN.

**Royal Dublin Society,** January 26.—Prof. H. H. Dixon in the chair.—Prof. W. **Brown**: The subsidence or damping of torsional oscillations in iron wires is much less than in nickel wires, and is greater in an alternating magnetic field than in a direct field, whilst the reverse is the case with soft nickel wires. With iron wires when the longitudinal load on the wire is sufficiently increased, the damping curves obtained in the direct and alternating magnetic field are identical. Results are also given for iron wires alloyed with silicon, chromium, and nickel, as well as for two non-magnetic wires.—Prof. H. H. **Dixon** and W. R. G. **Atkins**: Osmotic pressures in plants. V.—Seasonal variations in the concentration of the cell sap of some deciduous and evergreen trees. A series of cryoscopic and conductivity measurements made on the sap pressed from plant organs after treatment with liquid air showed that the greater part of the osmotic pressure is due to dissolved carbohydrates. The concentration of electrolytes in leaves increases with age. A similar increase was not found in the roots of *Ilex aquifolium*. The concentration of carbohydrates fluctuates greatly, and causes large variations in the osmotic pressure. In the leaves of *Syringa vulgaris* it was found that the osmotic pressure rose from the opening of the buds and reached its maximum in August. The leaves of both Ilex and Hedera showed higher osmotic pressures in winter than in summer. The osmotic pressure of the tissues of the roots of Ilex attained its maximum in September.

PARIS.

**Academy of Sciences,** February 8.—M. Ed. Perrier in the chair.—A. **Lacroix**: The existence of grained nepheline rocks in the volcanic archipelago of Kerguelen.—G. **Bigourdan**: Application of the angular comparator to the determination of astronomical refraction and its constant. Details of the proposed method for using the instrument described in a recent paper to measure atmospheric refraction.—Armand **Gautier**: The influence of fluorine on plant growth. In certain rare cases the presence of fluorides in the soil inhibits growth, but in general it has a stimulating effect on growth, flowering, and the formation of seeds.—Ed. **Delorme**: Wounds of the external genital organs.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the second quarter of 1914. Observations were made on seventy-one days, and the results are given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—E. **Goursat**: A class of integral invariants.—Et. **Delassus**: The theory of unilateral finite linkages.—Léon **Bloch**: The theory of absorption of light in metals and in insulators.—F. **Bodroux**: The preparation of esters. Mixtures of alcohol, water, and formic acid give formates on slow distillation, but formic acid has very slight catalytic power in ester formation from other acids. The mixture of sulphuric and hydrobromic acids obtained by decolorising a mixture of bromine and water with sulphur dioxide is recommended as a catalyst, and details are given of its use in the preparation of propyl and *iso*butyl bromides.—L. **Grimbert** and O. **Bailly**: A method for distinguishing the glycerophosphoric mono-esters and on the constitution of crystallised sodium glycerophosphate.—A. **Sartory** and L. **Spillmann**: The bacteriology of gaseous gangrene. In agreement with the results of Weinberg, Doyen, and Yamanouchi, the authors find present in all cases *Bacillus perfringens* in the gangrene pus. Other organisms are present, but this bacillus appears to be the most important as regards pus formation.—P. **Mazé**: The determination of the rare mineral elements necessary to the development of maize. Boron, aluminium, fluorine, and iodine are necessary for the growth of maize.—Em. **Bourquelot**, M. **Bridel**, and A. **Aubry**: The biochemical synthesis of the β-monoglucoside of ordinary propylene glycol with the aid of emulsin.

## *BOOKS RECEIVED.*

International Association for Tropical Agriculture. Proceedings of the Third International Congress, held at the Imperial Institute, London, S.W., June 23 to 30, 1914. Pp. xi+407. (London: John Bale, Ltd.) 10*s*. net.

A List of British Birds, compiled by a Committee of the British Ornithologists' Union. Second and revised edition. Pp. xxii+430. (London: W. Wesley and Son.) 7*s*. 6*d*.

Canadian Institute. General Index to Publications, 1852–1912. Compiled and edited by J. Patterson. Pp. 518. (Toronto: University Press.) 5 dollars.

Bartholomew's Route Chart of the World, with Inset Maps (Edinburgh: J. Bartholomew and Co.) 1*s*. net.

Practical Mathematics. By A. E. Young. Second Year. Pp. xi+164. (London: G. Routledge and Sons, Ltd.) 2*s*. net.

A First Course in Practical Chemistry for Rural Secondary Schools. By W. Aldridge. Pp. xii+122. (London: G. Bell and Sons, Ltd.) 1*s*. 6*d*.

Practical Heat, Light and Sound. By T. Picton. Pp. xv+151. (London: G. Bell and Sons, Ltd.) 1*s*. 6*d*.

Manuale di Fisica. By Prof. B. Dessau. Vol. ii. Acustica, Termologia, Ottica. Pp. vii+612. (Milano: Società Editrice Libraria.) L.15.

Tables Annuelles de Constantes et Données

Numériques: Données Numériques de Biologie, Biochimie, Chimie Physique Biologique, Physiologie, Microbiologie, Pharmacodynamie. By E. F. Terroine. Pp. xi+20. Cristallographie et de Minéralogie. By L. J. Spencer. Pp. viii+425–446. Radioactivité Atomistique. Electronique et Ionisation. By J. Saphores and F. Bourion. Pp. viii+295–307. Spectroscopie. By Dr. L. Brüninghaus. Pp. viii+165–238. L'Electricité, Magnétisme et Electrochimie. By Profs. P. Dutoit and W. C. McC. Lewis, and Dr. A. Mahlke. Pp. ix+258–417. Art de l'Ingénieur et Métallurgie. By S. L. Archbutt and others. Pp. viii+510–600. (Paris: Gauthier-Villars et Cie.)

The Hydrogenation of Oils, Catalyzers, and Catalysis, and the Generation of Hydrogen. By C. Ellis. Pp. x+340. (London: Constable and Co., Ltd.) 16s. net.

Catalogue of Scientific Papers. Fourth Series (1884–1900). Compiled by the Royal Society of London. Vol. xiv., C—Fittig. Pp. 1024. (Cambridge University Press.) 2l. 10s. net.

The Extra Pharmacopœia of Martindale and Westcott. Revised by Dr. W. H. Martindale and W. Wynn Westcott. Sixteenth edition. In 2 vols. Vol. i., pp. xl+1113. Vol. ii., pp. viii+469. (London: H. K. Lewis.) Vol. i., 14s. net; vol. ii., 7s. net.

Mathematical Papers for Admission to the Royal Military Academy and the Royal Military College for the Years 1905–14. Edited by R. M. Milne. (London: Macmillan and Co., Ltd.) 6s.

The Next Generation. By F. G. Jewett. Pp. xi+235. (Boston, New York, Chicago, London: Ginn and Co.) 3s. 6d.

## DIARY OF SOCIETIES.

*THURSDAY*, FEBRUARY 18.

ROYAL SOCIETY, at 4.30.—Gaseous Combustion at High Pressures: Prof. W. A. Bone and Others.—The Orbits of a Charged Particle Round an Electric and Magnetic Nucleus; Prof. W. M. Hicks.—The Lunar Diurnal Magnetic Variation and its Change with Lunar Distance: S. Chapman.—Some Temperature Refraction Coefficients of Optical Glass: Lt.-Col. J. W. Gifford.

ROYAL INSTITUTION, at 3.—Struggle of Species: Dr. P. Chalmers Mitchell.

LINNEAN SOCIETY, at 5.—The Action of Light upon Chlorophyll: H. Wager.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The "Cracking" of Oils, with a View to Obtaining Motor Spirit and other Products: W. A. Hall.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on some Gold Occurrences in Ashanti: J. Morrow Campbell.—Some Features in the Mining Problems of the East Witwatersrand Area: W. G. Holford.—Prospecting Tin Land in Malaya: W. B. Middleton.

*FRIDAY*, FEBRUARY 19.

ROYAL INSTITUTION, at 9.—The Visit of the British Association to Australia: Prof. H. E. Armstrong.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—Convertible Combustion Engines: A. E. L. Chorlton.

*SATURDAY*, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—Recent Researches on Atoms and Ions: Sir J. J. Thomson.

*MONDAY*, FEBRUARY 22.

ROYAL SOCIETY OF ARTS, at 8.—Motor Fuels: Prof. Vivian B. Lewes.

INSTITUTE OF ACTUARIES, at 5.—Practical Points in Connection with the Formation and Valuation of Pension Funds, with a note on Group Assurances: J. Burn and F. P. Symmons.

*TUESDAY*, FEBRUARY 23.

ROYAL INSTITUTION, at 3.—Muscle in the Service of Nerve: Prof. C. S. Sherrington.

ZOOLOGICAL SOCIETY, at 5.30.—(1) Abnormal Gills in the Starfish, *Porania pulvillus* O.F.M. (2) The Ciliation of Asterids, and the Question of Ciliary Nutrition in Certain Species: Dr. J. F. Gemmill.—The Methods of Feeding and the Mouth-parts of the Larva of the Glow-worm (*Lampyris noctiluca*): Miss Kathleen Haddon.—Descriptions of New Fossorial Wasps from Australia: R. E. Turner.—Notes on a small Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911–12: Lt.-Col. J. M. Fawcett.

ROYAL ANTHROPOLOGICAL INSTITUTE, Joint Meetings with THE PREHISTORIC SOCIETY OF EAST ANGLIA, at 2.30, at the Royal College of Surgeons.—Papers by members of the Prehistoric Society; at 8.15.—Ouse Valley Cultures: Charles Dawson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Electrolytic Action of Return Currents in Electric Tramways on Gas and Water-Mains, and the Best Means of Providing against Electrical Disturbances: H. E. Yerbury.

*WEDNESDAY*, FEBRUARY 24.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Africa after the War: Sir Harry H. Johnston.

ROYAL SOCIETY OF ARTS, at 8.—The Economics of the War: Prof. W. J. Ashley.

GEOLOGICAL SOCIETY, at 8.—The Ashgillian Succession in the Tract to the West of Coniston Lake: Dr. J. E. Marr.—The Radioactive Methods of Determining Geologic Time: H. S. Shelton.

*THURSDAY*, FEBRUARY 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Effect of the Depth of Pulmonary Ventilation on the Oxygen in the Venous Blood of Man: J. F. Twort and Prof. L. Hill.—The Function of Chlorophyll: Dr. A. J. Ewart.—Contributions to the Study of the Bionomics and Reproductive Processes of the Foraminifera: E. Heron-Allen.—The Influence of the Hydrogen Concentration upon the Optimum Temperature of a Ferment: A. Compton.

ROYAL INSTITUTION, at 3.—Struggle of Nations: Dr. P. Chalmers Mitchell.

CHILD STUDY SOCIETY, at 6.—*Discussion*: The Care and Development of the Child—from Ante-Natal Period to Five Years of Age. Ante-Natal Period: Dr. G. Eric Pritchard; Infancy: Miss J. Halford; One to Five Years: Dr. D. Forsyth.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electricity applied to Mining: C. P. Sparks.

*FRIDAY*, FEBRUARY 26.

ROYAL INSTITUTION, at 9.—Solar Eclipse of 1914: The Rev. A. L. Cortie.

*SATURDAY*, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—Recent Researches on Atoms and Ions: Sir J. J. Thomson.

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*Editorial and Publishing Offices:*
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.

*Advertisements and business letters to be addressed to the Publishers.*
*Editorial Communications to the Editor.*

*Telephone Number:* GERRARD 8830.
*Telegraphic Address:* PHUSIS, LONDON.